



NASA CR-120922
APCI TM 184

ATS 51016
N73-14716

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW

FINAL REPORT

Vol. I

JUNE 1972

CASE FILE
COPY



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Prepared for
AEROSPACE SAFETY RESEARCH AND DATA INSTITUTE
LEWIS RESEARCH CENTER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CLEVELAND, OHIO 44135

Under
NASA Contract NAS3-15083
Paul M. Ordin, Program Manager

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Volume I of Four Volumes

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ACKNOWLEDGMENTS

This investigation was initiated by Mr. I. Irving Pinkel, Director Aerospace Safety Research and Data Institute, NASA - Lewis Research Center, Cleveland, Ohio. The work was performed by Air Products and Chemicals, Inc., Allentown, Pennsylvania, under Contract No. NAS3-15083. Dr. A. Lapin was the Project Manager for Air Products and Chemicals, Inc. and Mr. P. M. Ordin was Program Manager for the Lewis Research Center.

This report is the result of the joint effort of a corporate wide team: a steering committee comprising Mr. W. L. Ball and Drs. A. Lapin and C. McKinley and about 15 additional senior personnel representing different departments and divisions. The efforts of Mrs. A. M. Powell and Miss S. L. Price in the preparation of the General Index, and of Mrs. K. F. Quay in the typing and preparation of the final report are appreciated. Special acknowledgment is made of the very significant contributions of Mssrs. I. Iverson, F. K. Kitson, H. H. Master, and W. W. Schmoyer.

The continual review and constructive criticism of Mssrs. P. M. Ordin, and G. Mandel, NASA - Lewis, and of Mr. W. L. Ball and Dr. C. McKinley, Air Products and Chemicals, Inc. are gratefully acknowledged.

ABSTRACT

A thorough and detailed study of Air Products and Chemicals, Inc. and Air Products Ltd. practices in the design and use of equipment in oxygen service, was performed. The report includes Liquid and Gaseous Oxygen Safety Review information covering: Material Compatibility, Operational Hazards, Maintenance Programs, Systems Emergencies, and Accident/Incident Investigations and Reports, and a set of references. Areas requiring further research and development for systems involving exposure to oxygen environment have been identified. An index to the Liquid and Gaseous Safety Review Data Forms and a General Index have been included to allow for easy retrieval of the reported information.

INTRODUCTION

The NASA Aerospace Safety Research and Data Institute (ASRDI) is responsible for providing NASA and its contractors with technical information and consultation on safety problems. To assist in this effort, a thorough and detailed study of Air Products and Chemicals, Inc. (APCI) and Air Products Ltd. (APL) practices in the design and use of equipment in oxygen service, has been performed in accordance with the terms of NASA Contract NAS3-15083.

The purpose of this study was to provide ASRDI with some of the industrial information needed for their oxygen safety review program which has the following objectives:

1. Providing early recommendations to improve NASA's oxygen handling by comparing NASA and contractor oxygen systems design, inspection, operation, maintenance and emergency procedures with those practiced in industry, universities and other government establishments. These systems include those used on space vehicles, aircraft, test and service facilities, surface vehicles, and disposal systems.
2. Assessing the vulnerability of NASA and contractor oxygen equipment to failure from a variety of sources so that hazards may be defined and remedial measures formulated.
3. Filling gaps in knowledge on oxygen handling through analysis and research in order to provide a better data base for the design of oxygen system and associated safety equipment, and for the formulation of meaningful tests, inspections, and emergency procedures.
4. Issuing criteria and standards on all aspects of oxygen handling and disposal.
5. Providing insight into the key processes that control the performance of oxygen systems and their components as an aid to design and operation, particularly under off-design or emergency conditions.

Specific questions concerning oxygen safety were included in the contract in the form of an Oxygen Safety Review Data Form and Check List. These provided guidelines as to the type of information desired and included a format for identifying referenced documents. A brief summary of each main heading of the NASA Safety Review Check List includes the following:

I. Material Compatibility

- A. List of materials used or contained in liquid and gaseous oxygen systems.

The materials used in oxygen systems, whether in direct contact with oxygen, or exposed to oxygen rich air as a result of leaks or accidents are individually considered under this heading. Methods and tests used to evaluate the compatibility of the materials in an oxygen environment are described. References are listed whenever applicable. Allowable oxygen environments are specified for each one of the materials listed.

B. Compatibility Checks

The compatibility considerations of materials in the oxygen systems are discussed and information on how the areas of possible concern in oxygen systems are handled is provided. Design criteria, cleaning procedures and quality control methods are covered in detail.

II. Operational Hazards

Guidelines, codes, regulations and special procedures used in the design, installation, fabrication, testing and operations for protection against hazards involved with production, transportation, storage and system handling of oxygen are presented with a list of related references.

III. Maintenance Programs

The Company practices employed in the oxygen systems maintenance programs to minimize both accident probabilities and consequences of accidents and/or incidents are described. Appropriate sections of the Operations Department and Industrial Gas Division Operating Manuals are discussed.

IV. Systems Emergencies

The practices employed to handle emergencies are spelled out in some detail. Training, warning, and protection of personnel and equipment are discussed.

V. Accident/Incident Investigations and Reports

A review is made of accidents involving oxygen which occurred in the industry in general, and in the company in particular. Accident reports are presented whenever available.

An Air Products and Chemicals, Inc. steering Committee consisting of:

| | |
|-------------|---|
| W. L. Ball | Corporate Safety Director |
| A. Lapin | Project Manager |
| C. McKinley | Cryogenic Systems Division - R&D Director |

reviewed the information generated by a task force of 15 senior engineers and supervisory personnel who have been instrumental in shaping the company safety policies throughout the years and who represented the following Divisions and Departments of the Company:

Air Products Limited

Corporate Safety Department

Cryogenic Systems Division:

Central Design Engineering Department

Electro-Machinery Department

Operations Department

Project Engineering Department

Research and Development Department

Industrial Gas Division

Engineering Department

Industrial Products Division

Quality Control Department

Metallurgical Services Division

Gas Equipment Department

This review was supplemented by interviews, discussions, and visits to several APCI and APL air separation plants and manufacturing facilities both in the U.S. and Europe. This information was then summarized and used in the preparation of the Oxygen Safety Review Forms. In most instances, an individual Form was used to cover the practices of one department, thus resulting in some duplication when two different departments reported on the same type of activity. For example, both APCI and APL's cleaning procedures and practices are separately covered in Forms IB1c-1 and IB1c-2 respectively. In general there was no attempt to identify differences existing between the practices of the different departments, since this was not within the scope of the program.

It should be noted that the Air Products material covers an experience period of over 15 years, therefore some contradictions may exist between new and old documents in particular if they originated in different departments. Where such differences exist through evolutionary changes in practice, the latest Air Products document is controlling.

It is interesting to note that while the Corporate and Divisional Safety Criteria are generally followed throughout the company, local conditions sometimes require special treatment as determined by local managers. For example, the Plant Manager at the Hettingen Plant in Germany, instituted a system of valve locks and keys to insure that liquid oxygen is delivered to liquid oxygen tankers only, thus eliminating the possibility of loading the wrong product in the liquid tanker. Differences in procedures between plants are also necessitated by the fact that in some areas the truck drivers are APCI employees, while in others they belong to other organizations under contract to APCI. In addition some plants service only APCI tankers while

others service APCI tankers and others as well. Similarly some customer installations require different or additional precautions as determined by the specifics of the locations, usage, etc. Safety Criteria in these cases are determined by the Departments involved in conjunction with the Safety Department.

It seems that assuring safety in a large organization in which a large number of special local conditions require modifications to the general safety criteria, could best be achieved by the following two-phase approach:

1. Criteria Establishment

Safety criteria and philosophy are established by the Safety Department with strong technical support from the Research and Development Department. These criteria will identify material compatibility, design concepts, contaminant types and levels acceptable to specific applications, systems evaluations, and other significant factors.

2. Criteria Implementation

Implementation of safety criteria is the responsibility of all levels of supervision and all personnel. This is achieved by education and training in such a way, that safety implementation becomes second nature. The objective is clear understanding of general philosophy and criteria, so that implementation of safety is achieved, and that changes necessary to accommodate specific local conditions can be made by knowledgeable personnel without endangering the desired goals.

ORGANIZATION OF REPORT

The report consists of the following parts:

1. Recommendations for Research and Development

2. Index to Liquid and Gaseous Safety Review Data Forms

This index lists the Review Data Forms in numerical sequence. It identifies each form by number, title, date and number of pages.

3. Liquid and Gaseous Oxygen Safety Review Data Forms

This part of the report closely follows the NASA Oxygen Safety Review Check List and Review Data Form (Attachments I and II of NASA Contract No. NAS3-15083). In fact the forms numbering system corresponds to the NASA Documents numbering system. Thus, Form IA2a-7 is the 7th APCI Form with information requested in paragraph IA2a of the NASA Review Check List which relates to the Material Compatibility of Sealants and Threading Compounds. The organization of the form itself is in close conformity with the suggested NASA Review Data Form. The APCI Data Review Form includes only those sections of the NASA Form which apply to the particular subject.

4. General Index

The General Index covers all Documents referred to in the Data Review Forms, the Data Review Forms themselves, and an additional number of documents related to the subject of oxygen, oxygen handling and safety. The General Index consists of five sections:

- a. Numerical Section: All documents are listed in numerical sequence, starting from 990000010. (The 9th digit, which is always a zero, except in one case 99000261A, should be ignored).
- b. Authors Section: All documents are listed alphabetically by each one of the authors.
- c. Corporate Titles Section: All documents are reported alphabetically by the name of the Corporation or Institution which originated the document. For example, a paper authored by a member of Lehigh University, will appear under Lehigh University. Similarly, the reports by C. F. Key of NASA will appear with the NASA grouping.
- d. Subjects Section: All documents are listed alphabetically by each one of the main words of the document title, and by key words which were added, whenever desirable.
- e. Source Section: All documents are listed in alphabetical order in accordance to their source identification such as AICHe-CEP-TECH-MANUAL for an American Institute of Chemical Engineer publication or DMIC-MEMO-163, for the Battelle Memorial Institute Report identified as Publication DMIC-MEMO-163.

The General Index arrangement thus allows information retrieval from several bases. For example, a lubricant covered by this study, can be found under L, with all other lubricants, or by looking up its specific name, such as Krytox. All documents referring to this item will be identified and could then be found in the Reference Section of the report, by looking up the Document Numbers.

5. References

This section contains all documents included in the General Index, in a numerical sequence. The APCI documents are reproduced in full and are released for general distribution and availability with the exception of the following documents which are not released and are not available for general distribution:

99000234
99000247
99000258
99000308
99000388
99000389
99000392
99000393
99000394
99000395
99000421

Only one page is included in the Reference Section for each non APCI document, with sufficient information to provide full identification and retrieval.

A number of additional documents have been included in this section even though they were not referred to in the Review Forms. These documents are related to oxygen safety and could be of interest to the reader. Some of them are listed below:

APCI Documents #9900007 and 99000017 provide the properties of gaseous and liquid oxygen.

APCI Documents #99000060 through 99000065 and 99000069 describe Research and Development work performed in the early 60's.

APCI Documents #99000306, 99000312 and 99000313 cover recent work using the O₂ Index as one factor in determining acceptability of materials for oxygen service.

APCI Document #99000340 briefly describes APCI procedure for the determination of material compatibility with oxygen.

APCI Document #99000595 is an APCI report on the experimental burning of metals in oxygen atmosphere and includes an appendix containing the abstracts of 43 papers on the ignition of metals.

RECOMMENDATIONS FOR RESEARCH AND DEVELOPMENT

In order to determine acceptance of materials for oxygen service and the safety of the system itself, it is essential to have material properties and criteria for acceptability as follows:

1. Material Properties as a Function of Oxygen Concentration and Pressure

Some or all of the following information is required to evaluate a material for oxygen service.

- a. Material identification
- b. Ignition temperature
- c. Ignition energy
- d. Oxygen index
- e. Calorimetric heat values
- f. Adsorption capacity for oxygen
- g. Autoignition temperature
- h. High pressure compatibility
- i. Behavior under impact conditions

Literature should be carefully reviewed so that available information is evaluated and used. Laboratory work may be needed to supplement available information.

2. Systems Behavior

In any industrial hazard situation, the amount of ignition energy to ignite a material in oxygen or oxygen rich environment is importantly related to the material and intensity of the energy input. It is also related in an extremely important fashion to the entire system. The dynamics of the ignition process is also a function of the entire system. It is therefore necessary to carefully examine and evaluate each individual component as

well as the subsystems and total system for behavior in an oxygen atmosphere as a function of oxygen concentration, pressure, and temperature.

3. Criteria for Acceptability

Criteria will have to be established for the acceptability of materials in oxygen service based on the material properties and examination of the system or subsystem, in which the materials are used. These criteria should be based on the following:

- a. Acceptance of materials per se.
- b. Limits on the quantity of materials in the specific system being examined.
- c. Level and type of allowable contamination for the application.
- d. Limits of temperature, pressure and oxygen concentrations.
- e. Inspection and quality control procedures.

Review of the available information regarding oxygen compatibility of materials indicates that additional information in the following areas may be required for the complete safety evaluation of a specific system.

1. Material Properties

Material properties needed for oxygen compatibility evaluation are usually available in the technical literature. However, this information is sparse or lacking completely in the case of new materials and for high pressure (3,000-10,000 psi) applications. In these instances, it will be necessary to acquire the needed properties by experimental determination.

2. Significant Testing

A number of tests are being used to determine material compatibility in the presence of oxygen. However, these tests are usually not closely related to the main characteristics of the system in which these materials are used. For example, impact testing is a widely used criterion for material acceptance, even when impact is not a factor of the specific application under consideration. The amount of energy needed to ignite a material is importantly related to the material itself, its physical dimensions, to the character and intensity of the energy input, and in an extremely important fashion to the entire system. For example, massive metal sections clearly ignite less readily than do powders, wires, ribbons, and small sections. Therefore it is essential to devise appropriate tests which incorporate the potential hazards of the system, such as sparks, friction, or gas compression and the correct size of the test specimen. The results of these tests will be significant and will provide a more dependable basis for material selection for the contemplated service.

3. Effect of Contaminants on the Materials Suitability

In general, the bulk of the work in the area of oxygen compatibility is performed with meticulously clean materials. Contaminants are studied by themselves, independently of the materials that they would contaminate.

It is believed that some materials may be more detrimentally affected than others by the presence of contaminants. It is therefore necessary to consider the complete system in order to determine the possible sources, types and quantities of contaminants, so that appropriate testing conditions may be determined. These tests will help establish tolerable contamination levels for the system.

4. System Testing

Complete systems should be carefully examined to determine their oxygen compatibility. Even if each individual component is acceptable on its own, synergistic effects may render an assembly of these components unacceptable. Therefore, systems and subsystems may have to be tested before a decision can be made regarding oxygen suitability. The effect of contamination in this particular case is extremely important since reactions or chain reactions may be triggered by contamination with a resulting ignition and combustion of materials which would not otherwise have been ignited.

5. Criteria for Compatibility

Present criteria for oxygen compatibility are often based on one or two types of tests even when they are not closely related to the intended applications. It is recommended that the information obtained from new research programs be used to reexamine the present criteria to determine their validity. These programs should also provide the basis for new criteria which will integrate all available factors related to the compatibility of materials and to the system itself such as: oxygen phase, concentration, temperature and pressure, materials properties, systems characteristics, potential hazards and degree of exposure to life and equipment in case of a failure. It is envisioned that an all inclusive "System Compatibility Index" or "System Safety Factor" could be developed by applying an empirical coefficient to each pertinent factor, which would apply to all types of oxygen systems: high or low pressure applications, liquid or gas phase environment, simple or complex. This "System Compatibility Index" or "System Safety Factor" will provide a numerical system which will indicate the degree of safety of the system being examined and will enable sound comparisons between competing schemes.

The research and development programs that are needed to provide the required information for a complete safety evaluation of systems involving oxygen, should consist of a number of limited scope parts dealing with specific systems and/or subsystems. In general each part of the program should provide answers to the following questions for the system being studied:

1. Assessment of realistic hazards as opposed to laboratory hazards.
2. Criteria for cleaning and frequency of solvent washing.
3. Effect of rust and foreign particles in the oxygen streams of the system.

4. Maximum allowable level of contamination.
5. Relation between allowable level of contaminants and cleanliness requirements.
6. Frequency of equipment inspection.
7. Criteria for lubricant selection for air and oxygen service, if applicable.
8. Criteria for compatibility, in terms of quantity of materials, system pressure and temperature, and exposure.

It is recommended that all information presently available and being developed as a result of new research and development programs be readily retrievable.

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LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA
FORMS

I. Material Compatibility

Lubricants

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| IA1a-1 | Krytox 143 AA Oil (duPont) | February 21, 1972 | 1 page |
| IA1a-2 | Halocarbon 11-21E, Halocarbon Products Corporation | February 21, 1972 | 1 page |
| IA1a-3 | Halocarbon 11-14E, Halocarbon Products Corporation | February 21, 1972 | 1 page |
| IA1a-4 | Halocarbon 6-25 Wax, Halocarbon Products Corporation | February 21, 1972 | 1 page |
| IA1a-5 | Kel F-90 grease, Minnesota Mining & Manufacturing Co. | February 21, 1972 | 1 page |
| IA1a-6 | Halocarbon 25-5S grease, Halocarbon Products Corporation | February 21, 1972 | 1 page |
| IA1a-7 | Fluorolube, FS, Hooker Chemical | February 21, 1972 | 1 page |
| IA1a-8 | Krytox 143 AB oil (duPont) | February 21, 1972 | 1 page |
| IA1a-9 | Krytox 143 AC oil (duPont) | February 21, 1972 | 1 page |
| IA1a-10 | Krytox 143 AZ oil (duPont) | February 21, 1972 | 1 page |
| IA1a-11 | Fluorolube, FS 5, Hooker Chemical | February 21, 1972 | 1 page |
| IA1a-12 | Molylube "N" Bel-Ray Co., Farmingdale, New Jersey | February 21, 1972 | 1 page |
| IA1a-13 | Moly Lube No. 99, Moly Lube Products, Glen Cove, New York | February 21, 1972 | 1 page |
| IA1a-14 | Fluoro-glide, Chemplast Inc. | February 21, 1972 | 1 page |
| IA1a-15 | Krytox 143 AD oil (duPont) | February 21, 1972 | 1 page |
| IA1a-16 | Voltalef 3A (Kingsley and Keith Limited, United Kingdom) | February 21, 1972 | 1 page |
| IA1a-17 | Esso Beacon 325 | February 21, 1972 | 1 page |
| IA1a-18 | Formblin Y04 (Montecatini - Edison) | February 21, 1972 | 1 page |

Sealants & Threading Compounds

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| IA2a-1 | Permatex #1516 | February 21, 1972 | 1 page |
| IA2a-2 | Teflon Tape -- Permacel | February 21, 1972 | 2 pages |
| IA2a-3 | T-Film, Eco Manufacturing Co. | February 21, 1972 | 1 page |
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| IA2a-6 | Crosslite Fluorocarbon Tape | February 21, 1972 | 2 pages |
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| IA2a-11 | 3M Fluorocarbon Tape | February 21, 1972 | 2 pages |
| IA2a-12 | Sodium Silicate and China Clay Paste | February 21, 1972 | 1 page |

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| IA3a-2 | Transite, Johns-Manville | February 21, 1972 | 1 page |
| IA3a-3 | Glass Wool | February 21, 1972 | 1 page |
| IA3a-4 | Mineral Wool | February 21, 1972 | 2 pages |
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| IA3a-6 | Milfoam -- Milfoam Corporation | February 21, 1972 | 1 page |
| IA3a-7 | National Gypsum Blue - National Gypsum Corporation | February 21, 1972 | 1 page |

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| IA4a-1 | RTV-60, Silicone Rubber Compound with SS-4004 silicone primer, G. E. Thermolite-12 curing catalyst | February 21, 1972 | 1 page |
| IA4a-2 | Keene Binder | February 21, 1972 | 1 page |
| IA4a-3 | Kel-F 81 | February 21, 1972 | 1 page |
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| IA5a-1 | Graphite Impregnated Asbestos Packing | February 21, 1972 | 1 page |
| IA5a-2 | TFE-GF-Green, Melrath Gaskets Co. | February 21, 1972 | 1 page |
| IA5a-3 | Vallegreen, Valley Forge Gasket Co. | February 21, 1972 | 1 page |
| IA5a-4 | Fluorogreen E-600, John Dore Co. | February 21, 1972 | 1 page |
| IA5a-5 | Melrath 150 -- sheet asbestos gasket material, Melrath Gasket Co. | February 21, 1972 | 1 page |
| IA5a-6 | KM226 Sheet asbestos gasket material, Nicolet Industries Inc. | February 21, 1972 | 1 page |
| IA5a-7 | Garlock 900, sheet asbestos gasket material, Garlock Mfg. Co. | February 21, 1972 | 1 page |
| IA5a-8 | Vulcanized Red Fibre Gaskets | February 21, 1972 | 1 page |
| IA5a-9 | KM246 sheet asbestos gasket material Nicolet Industries | February 21, 1972 | 1 page |

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| IA5a-12 | Sindanyo. CS 51 Asbestos and Cement Boards. Natural untreated finish (Turners Asbestos Cement Co. Ltd. United Kingdom). | February 21, 1972 | 1 page |
| IA5a-13 | Klingerit 661 (Richard Klinger Limited United Kingdom). | February 21, 1972 | 1 page |
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| IA6a-4 | Copper Pipe ASTM B42 | February 21, 1972 | 1 page |
| IA6a-5 | Copper tube ASTM B75 | February 21, 1972 | 2 pages |
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| IA6a-14 | Carbon Steel - (Oxygen Service) | February 21, 1972 | 3 pages |
| IA6a-15 | Stainless Steel ASTM A312 TP304 | February 21, 1972 | 2 pages |
| IA6a-16 | Stainless Steel ASTM A240 304 | February 21, 1972 | 2 pages |
| IA6a-17 | Stainless Steel ASTM A403 WP304 and A403 WP304L | February 21, 1972 | 2 pages |
| IA6a-18 | Stainless Steel ASTM A320 B8304 | February 21, 1972 | 2 pages |
| IA6a-19 | Stainless Steel ASTM A194 8T321 | February 21, 1972 | 2 pages |
| IA6a-20 | Stainless Steels, Type 416 Cadmium Plated | February 21, 1972 | 1 page |
| IA6a-21 | Stainless Steel ASTM A182 F 304 and ASTM A182 F316 | February 21, 1972 | 2 pages |
| IA6a-22 | Stainless Steel, type 304, unidentified as to ASTM spec. | February 21, 1972 | 2 pages |
| IA6a-23 | Copper-Silicon ASTM B98GrB | February 21, 1972 | 2 pages |
| IA6a-24 | Free Machining Brass | February 21, 1972 | 2 pages |
| IA6a-25 | Beryllium Copper | February 21, 1972 | 2 pages |
| IA6a-26 | Stainless Steel ASTM A269 304 | February 21, 1972 | 2 pages |
| IA6a-27 | Bronze ASTM B61 or B62 | February 21, 1972 | 2 pages |
| IA6a-28 | Brass sheet or plate, ASTM B36 | February 21, 1972 | 2 pages |
| IA6a-29 | Monel, ASTM B164 | February 21, 1972 | 2 pages |
| IA6a-30 | Stainless Steel ASTM A351 Gr CF8 | February 21, 1972 | 2 pages |

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| IA6a-31 | Stainless, 9% Nickel Steel, ASTM A353GB | February 21, 1972 | 2 pages |
| IA6a-32 | Copper Tube ASTM B88 | February 21, 1972 | 1 page |
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| IA6a-35 | Silver | February 21, 1972 | 1 page |
| IA6a-36 | Novonox Stainless Steel Alloy To DIN (German National Standards), Composition: 5% Cr, 17% Ni, 4% Cu, Niobium Stabilizer, balance Fe. | February 21, 1972 | 1 page |
| IA6a-37 | Muntz Metal 60/40 Type, Composition: Cu 58-61%, Zn 38.5-42%, Pb 0.35-0.9% | February 21, 1972 | 1 page |
| IA6a-38 | Alpha Brass Tube Type TCL 100 or DFD 5019 (Tungum Company Limited, U.K.) Composition: Copper 86%, Alum. 1.2%, Nickel 1.4%, Silicon 1.3%, Iron 0.25%, Lead .05%, Tin 0.1%, Manganese 0.1%. Total other impurities 0.5%, Zinc Remainder. | February 21, 1972 | 1 page |

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| IA7a-5 | Trichloroethylene | February 21, 1972 | 1 page |
| IA7a-6 | Methylene Chloride | February 21, 1972 | 1 page |

Compatibility Checks

| | | | |
|-----------|--|-------------------|----------|
| IB1c-1 | Fire Compatibility Cleaning Procedures - APCI | February 21, 1972 | 14 pages |
| IB1c-2 | Fire Compatibility Cleaning Procedures - APL | February 21, 1972 | 1 page |
| IB1d(1)-1 | Fire Compatibility Quality Control, Fire Hazards | September 9, 1971 | 2 pages |
| IB1d(2)-1 | Fire Compatibility Quality Control - APCI, Programs | September 9, 1971 | 3 pages |
| IB1d(2)-2 | Fire Compatibility Quality Control - APL, Programs | February 21, 1972 | 2 pages |
| IB2-1 | Structural Materials Compatibility Effects of Oxygen Diffusion | February 10, 1972 | 2 pages |
| IB2a-1 | Structural Materials Compatibility Relationship of Material Strength to Maximum Stress Over the Working Temperature Range | September 2, 1971 | 2 pages |
| IB2c-1 | Structural Materials Compatibility Notch Sensitivity | September 2, 1971 | 1 page |

Compatibility Checks (Continued)

| | | | |
|-----------|--|-------------------|--------|
| IB2d-1 | Structural Materials Compatibility Fabrication and Welding | October 28, 1971 | 1 page |
| IB2e(2)-1 | Structural Materials Compatibility Materials and Parts Suitability Controls Vendor Procedures on Purchased Equipment | September 2, 1971 | 1 page |

II. Operational Hazards

Overpressure

| | | | |
|--------|---|-------------------|---------|
| IIA-1 | Overpressure | February 18, 1972 | 2 pages |
| IIA4-1 | Integrity of Insulation Shop Fabricated LOX Storage Tanks | December 30, 1971 | 1 page |
| IIA4-2 | Integrity of Insulation Field Fabricated, flat bottom LOX Storage Tanks | December 30, 1971 | 1 page |

Disposal of Vented Gases

| | | | |
|--------|---|-------------------|---------|
| IIB-1 | Company Practices | November 1, 1971 | 5 pages |
| IIB1-1 | Cleanliness of Disposal System (compatibility with oxidizer) | February 12, 1972 | 2 pages |
| IIB1-2 | Cleanliness of Oxygen Piping | February 19, 1972 | 1 page |
| IIB4-1 | Procedural Arrangements | February 19, 1972 | 1 page |

Coupling to Other Systems

| | | | |
|--------------------|---|-------------------|--------|
| IIC1-1 & IIC2-1 | Isolation Arrangements (leakage) Temperature Isolation | December 22, 1971 | 1 page |
|--------------------|---|-------------------|--------|

Spills and Leakage

| | | | |
|--------|---|-------------------|---------|
| IID-1 | Spills and Leakage - General | September 3, 1971 | 2 pages |
| IID1-1 | Drainage and Ultimate Disposal Arrangements | August 22, 1971 | 2 pages |
| IID2-1 | Separation of Incompatible Materials and Ignition Sources in Disposal Systems | August 22, 1971 | 1 page |
| IID3-1 | Environmental Warnings and Escape Systems | August 22, 1971 | 1 page |
| IID4-1 | Detection: Quantity and Response Time Limits | August 22, 1971 | 1 page |

Contaminants Accumulation

| | | | |
|-------|--|---------------|--------|
| IIE-1 | Procedures for Solvent Evaporation Technique, and for Extraction of Ether Soluble Material & Oil Content Determination | July 21, 1971 | 1 page |
|-------|--|---------------|--------|

Oxygen Transfer

| | | | |
|---------|--|-------------------|---------|
| IIF1-1 | Production to Storage, Storage to System, Storage to Transport, Transport to System | December 22, 1971 | 1 page |
| IIF1-2 | Production, Storage to System, Storage to Transport, Transport to System Loading and Unloading Procedures for Liquid Oxygen Transfer | August 22, 1971 | 1 page |
| IIF1-3 | Systems - Field Fabricated Cryogenic Liquid Storage Tanks | February 3, 1972 | 1 page |
| IIF1-4 | Systems - APL Oxygen Transfer Methods Typical Installations, and Operations Department Overhaul Procedures for Liquid Pumps. | February 21, 1972 | 1 page |
| IIF2-1 | Pipeline Transportation - List of Standards | February 8, 1972 | 2 pages |
| IIF2-2 | Pipeline Transportation - APL Oxygen Pipeline Design Concepts and Criteria | February 21, 1972 | 1 page |
| IIF2a-1 | Road, Railroad, Barge, and Pipeline Transportation Pressure Relief | August 22, 1971 | 1 page |
| IIF2b-1 | Road, Railroad, Barge, and Pipeline Transportation Contamination Control | September 3, 1971 | 1 page |
| IIF2c-1 | Road, Railroad, Barge and Pipeline Transportation Oxygen Dispersal From Vents and Lines | August 22, 1971 | 1 page |
| IIF2d-1 | Road, Railroad, Barge and Pipeline Transportation Vehicle Accident Procedures | August 22, 1971 | 1 page |
| IIF2e-1 | Road, Railroad, Barge and Pipeline Transportation Vibration and Controlled Sloshing | August 22, 1971 | 1 page |
| IIF3-1 | Malfunctions and Failures | November 12, 1971 | 1 page |
| IIF3-2 | Malfunctions and Failures APCI Incidents Involving Oxygen Transfer Equipment or Instrumentation | February 4, 1972 | 2 pages |
| IIF3-3 | Malfunctions and Failures Incidents which Occurred with Other Oxygen Equipment | February 3, 1972 | 2 pages |

Oxygen Transfer (Continued)

| | | | |
|------------|---|-------------------|----------|
| IIF3-4 | Equipment Malfunctions and Failures Compressors and Pumps | January 23, 1972 | 15 pages |
| IIF3a-1 | Equipment Malfunctions and Failures Equipment - Gas Pressure Regulators | December 10, 1971 | 3 pages |
| IIF3a(3)-1 | Malfunctions and Failures Equipment - Valves | December 30, 1971 | 1 page |
| IIF3b-1 | Malfunctions and Failures Geisering, Excessive Vibrations, Shock (Thermal and Pressure), Line Surges | February 18, 1972 | 1 page |
| IIF3c-1 | Malfunction and Failures Insulation System deterioration due to Vibrations | December 30, 1971 | 1 page |

Fires and Explosions

| | | | |
|-------|--|------------------|---------|
| IIG-1 | Methods to Contain or Restrict Combustible Mixtures | November 1, 1971 | 6 pages |
|-------|--|------------------|---------|

III. Maintenance Program

System Check and Inspection; Where, Why, and How

| | | | |
|---------|---|--------------------|---------|
| IIIA1-1 | Structure | September 12, 1971 | 1 page |
| IIIA2-1 | Leaks | September 12, 1971 | 1 page |
| IIIA3-1 | System Instrumentation and Controls | September 12, 1971 | 1 page |
| IIIA4-1 | Insulation | September 12, 1971 | 1 page |
| IIIA5-1 | General Considerations of the "aging" System | August 22, 1971 | 1 page |
| IIIA5-2 | Preventive Maintenance Program | September 12, 1971 | 5 pages |

Cleaning Procedures

| | | | |
|--------|--|------------------|---------|
| IIIB-1 | Safe Cleaning Procedures for Filters Traps, and Instruments | November 1, 1971 | 2 pages |
|--------|--|------------------|---------|

Pressure Testing

| | | | |
|--------|------------------------------------|--------------------|---------|
| IIIC-1 | Steps Followed in Pressure Testing | September 12, 1971 | 3 pages |
|--------|------------------------------------|--------------------|---------|

IV. System Emergencies

General

| | | | |
|------|---------------------------|-------------------|--------|
| IV-1 | APCI Emergency Procedures | December 23, 1971 | 1 page |
|------|---------------------------|-------------------|--------|

Safety Training and Area Placarding

| | | | |
|-------|------------------------------------|------------------|---------|
| IVA-1 | Safety Training Area Placarding | November 5, 1971 | 4 pages |
|-------|------------------------------------|------------------|---------|

Warning Devices

| | | | |
|-------|--|-------------------|---------|
| IVB-1 | Warning Devices for Oxygen Systems - General Applications | November 12, 1971 | 5 pages |
|-------|--|-------------------|---------|

Protection

| | | | |
|--------|--|------------------|---------|
| IVC1-1 | Personnel Protection & Equipment | January 13, 1972 | 6 pages |
| IVC2-1 | Buildings and Adjacent Systems Protection | January 10, 1972 | 4 pages |

Hazards Protection

| | | | |
|-------|---|-------------------|---------|
| IVE-1 | General Precautions | November 8, 1971 | 2 pages |
| IVE-2 | APL Bulletins and Reports on Various Problems Related to Oxygen Safety | February 21, 1972 | 1 page |

V. Accident/Incident Investigation and Report

| | | | |
|-----|--|-------------------|----------|
| V-1 | Accidents Involving Spills and Leakate | August 22, 1971 | 1 page |
| V-2 | Accidents Involving Oxygen Equipment and Systems which caused injury to personnel or damage to equipment and property are listed. | February 4, 1972 | 26 pages |
| V-3 | APL Safety Bulletins and APL Safety Departments Reports related to Accidents Involving Oxygen | February 21, 1972 | 2 pages |
| V-4 | APCI Documents List covering safety Precautions, Accidents, and Near Misses Involving Oxygen or Air Air Separation Plants | May 12, 1972 | 2 pages |

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Krytox 143 AA oil (duPont)

a. Specific Oxygen Environment

Normal exposure is to air, but may be exposed to gaseous or liquid oxygen at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

(1) Company Practices

- (a) Motor Bearing lubrication for liquid oxygen pump assemblies.

B. Information Sources

1. Company Practices

b. Company Operating Experience.

Was on a trial basis for replacement of Halocarbon lubricants which do not appear to have the lubricity and mechanical properties necessary for our application. However its performance was unacceptable.

c. Based on Research and Development of Others.

- (1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, P. 12, 13, August 23, 1968 (Doc. # 99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Halocarbon 11-21E, Halocarbon Products Corporation

a. Specific Oxygen Environment

Normal exposure is to air, but may be exposed to gaseous or liquid oxygen at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

(1) Company Practices

- (a) High pressure reciprocating pumps. Lubricant is not in direct oxygen contact, but in drive train of pump where the possibility of intimate contact exists.
- (b) As the hydraulic fluid in diaphragm compressors in oxygen service.
- (c) Not to be used with aluminum, magnesium, or their alloys under conditions of high torque or shear.

B. Information Sources

1. Company Practices

c. Based on Research and Development of Others

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 28, December 4, 1963 (Doc. # 99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Halocarbon 11-14E, Halocarbon Products Corporation

a. Specific Oxygen Environment

Normal exposure is to air, but may be exposed to gaseous or liquid oxygen at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

(1) Company Practices

- (a) Centrifugal liquid oxygen pump drive trains bearings where intimate contact is possible.
- (b) Vertically mounted multi-stage centrifugal liquid oxygen pump drive motor bearings
- (c) Not to be used with aluminum, magnesium, or their alloys under conditions of high torque or shear.

B. Information Sources

1. Company Practices

- (1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III," NASA TM X-53533, P. 12, Nov. 3, 1966, (Doc. #99000125).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Halocarbon 6-25 Wax, Halocarbon Products Corporation

a. Specific Oxygen Environment

Ambient temp. to 160°F up to 1500 psig gaseous oxygen

(1) Company Practices

(a) Protective coating of oxygen compressor spare parts and compressor components during storage. Coating is not removed prior to using equipment.

(b) Not to be used with aluminum, magnesium, or their alloys under conditions of high torque or shear.

B. Information Sources

1. Company Practices

e. Other

Schmoyer, W. W., "Oxygen Compressors", February 6, 1969 (Doc #99000138). Record of telecon with Halocarbon Products, Feb. 4, 1969. Wax 6-25 is a mixture of 25% Halocarbon 600 wax and 75% Freon 113. The Freon evaporates upon application leaving a protective coating on the surface.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Kel F-90 grease, Minnesota Mining & Manufacturing Co.

a. Specific Oxygen Environment

Gaseous Oxygen, ambient temp, pressures to 3000 psi.

(1) Company Practices

(a) Laboratory glassware, analyzers, and testing apparatus in contact with gaseous oxygen.

(b) Some lubricant function in valves in gaseous oxygen service.

(c) "O" ring and diaphragm lubricant in oxygen regulators

(d) Not to be used with aluminum, magnesium, or their alloys under conditions of high torque or shear.

(e) No longer manufactured. Will be replaced by Halocarbon 25-5S grease -- Refer IALa-6

B. Information Sources

1. Company Practices

a. Company Research

(1) Walde, R. A., Flammability and Explosion Hazards, APCI 87-0-8822, May 1963 (Doc. #99000072).

c. Based on Research and Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, P. 28, December 4, 1963 (Doc #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Halocarbon 25-5S grease, Halocarbon Products Corp.

a. Specific Oxygen Environment

Gaseous Oxygen, ambient temp., pressures to 3000 psi

(1) Company Practices

- (a) Laboratory glasswear, analyzers, and testing apparatus in contact with gaseous oxygen.
- (b) Some lubricant functions in valves in gaseous oxygen service.
- (c) "O" ring and diaphragm lubricant in oxygen regulators.
- (d) Not to be used with aluminum, magnesium, or their alloys under conditions of high torque or shear.

B. Information Sources

1. Company Practices

c. Based on Research and Development of Others.

- (1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV", NASA TM X-53773, p. 12, August 23, 1968 (Doc. #99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Fluorolube, FS, Hooker Chemical

a. Specific Oxygen Environment

Gaseous oxygen service, ambient temperature to -297°F
pressures to 3000 psig

(1) Company Practices

- (a) Internal threaded devices in Air Separation Plant distillation columns.
- (b) On teflon tape on some NPT screwed connections to improve the lubricity of the system for better seal.
- (c) Bonnet and stem threads and other valve parts exposed to oxygen service.
- (d) Not to be used with aluminum, magnesium, or their alloys under conditions of high torque or shear.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Ent, W. L., "Investigation of The Resistant Qualities of Cellulubes 220," TM #40, Sept. 18, 1959 (Doc. #99000140). Technical Memorandum TM No. 40 references LOX bomb tests of Hooker's Fluorolube FS and FS 5 and Kellog's Kel-F 3 oils.

b. Company Operating Experience.

Chlorotrifluoroethylene Family of lubricants are permitted to be used where lubricants are needed in contact with oxygen. Each application is reviewed.

c. Based on Research and Development of Others.

- (1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen III", NASA TM X-53533, p. 9, November 3, 1966, (Doc. #99000125).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Krytox 143 AB oil (duPont)

a. Specific Oxygen Environment

Normal exposure is to air, but may be exposed to gaseous or liquid oxygen at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

(1) Company Practices

- (a) Motor Bearing lubrication for liquid oxygen pump assemblies.

B. Information Sources

1. Company Practices

b. Company Operating Experience.

Was on a trial basis for replacement of Halocarbon lubricants which do not appear to have the lubricity and mechanical properties necessary for our application. However its performance was unacceptable.

c. Based on Research and Development of Others.

- (1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, P. 12, 13, August 23, 1968 (Doc. # 99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Krytox 143 AC oil (duPont)

a. Specific Oxygen Environment

Normal exposure is to air, but may be exposed to gaseous or liquid oxygen at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

(1) Company Practices

- (a) Motor Bearing lubrication for liquid oxygen pump assemblies.

B. Information Sources

1. Company Practices

b. Company Operating Experience.

Was on a trial basis for replacement of Halocarbon lubricants which do not appear to have the lubricity and mechanical properties necessary for our application. However its performance was unacceptable.

c. Based on Research and Development of Others.

- (1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, P. 12, 13, August 23, 1968 (Doc. # 99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Krytox 143 AZ oil (duPont)

a. Specific Oxygen Environment

Normal exposure is to air, but may be exposed to gaseous or liquid oxygen at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

(1) Company Practices

- (a) Motor Bearing lubrication for liquid oxygen pump assemblies.

B. Information Sources

1. Company Practices

b. Company Operating Experience.

Was on a trial basis for replacement of Halocarbon lubricants which do not appear to have the lubricity and mechanical properties necessary for our application. However its performance was unacceptable.

c. Based on Research and Development of Others.

- (1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, P. 12, 13, August 23, 1968 (Doc. # 99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Fluorolube, FS 5, Hooker Chemical

a. Specific Oxygen Environment

Gaseous oxygen service ambient temperature to -297°F , pressures to 3000 psig

(1) Company Practices

(a) Transmitters and liquid level gauges in oxygen service

B. Information Sources

1. Company Practices

a. Company Research

(1) Ent, W. L., "Investigation of The Resistant Qualities of Cellulubes 220," TM #40, Sept. 18, 1959 (Doc. #99000140). Technical Memorandum TM No. 40 references LOX bomb tests of Hooker's Fluorolube FS and FS 5 and Kellogg's Kel-F 3 oils.

(2) Foster, R. H., APCI Safety, Hazards, and Explosion Testing Ignition Test Apparatus, Florulube Greases, Epoxy Compounds Devcon 2 Ton and Devcon F, Foam Type Insulations -- Styrofoam and Polyurethane Foam Insulation, Raybestos Manhattan Packing and Impregnated Asbestos Rope Material, APCI MAR 87-0-8821, February 1962 (Doc. #99000066).

b. Company Operating Experience.

Chlorotrifluoroethylene Family of lubricants are permitted to be used where lubricants are needed in contact with oxygen. Each application is reviewed.

c. Based on Research and Development of Others.

(1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen III", NASA TM X-53533, p. 9, November 3, 1966, (Doc. #99000125).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Molylube "N" Bel-Ray Co., Farmingdale, N. J.

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperatures to -297°F pressures to 3000 psig.

(1) Company Practices

(a) Used in small capacity liquid oxygen reciprocating pumps to correct a seizure problem between stainless and aluminum thread joints.

(b) Used as thread lubricant on oxygen regulators

B. Information Sources

1. Company Practices

a. Company Research

(1) Brophy, M., R&D Tests of Oxygen Compatibility, R&D Notebook #130, p. 16 & 17, Feb. 11, 1963, (Doc. #99000120).

(2) Foster, R. H., APCI Safety, Hazards, and Explosion Testing -- Epon H-60, Polycel 440R, and Styrofoam, Lubricants, Moly Spray Kote, and Dri Lube, APCI MAR 87-0-8821, April 1962 (Doc. #99000068).

(3) Walde, R. A., APCI Flammability and Explosion Hazards, Oxygen Pressure Gauge TWF Wool, Spintex 305, Molykote Type Z and Type X-15, APCI MAR 87-0-8822, March 1963 (Doc. #99000071).

b. Company Operating Experience.

(1) Schmoyer, W. W., "Regulator Thread Sealant," Oct. 4, 1963, (Doc. #99000119).

c. Based on Research & Development of Others.

(1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, p. 14, August 23, 1968, (Doc. #99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Moly Lube No. 99, Moly Lube Products, Glen Cove, N. Y.

a. Specific Oxygen Environment

Exposure is to air at ambient temperature and atmospheric pressure excepting in cases of leaks in process system then the exposure is to gaseous and liquid oxygen, ambient temperature to -297°F , atmospheric pressure

(1) Company Practices

(a) Used as a lubricant for some screw threads on bolts and studs as an aid to disassembly of parts. Usually not in oxygen product stream.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Brophy, M., R&D Tests with High Pressure Oxygen, R&D Notebook #130, p. 31, June 1963, (Doc. #99000123). Bomb test at 2000 psig
- (2) Walde, R. A., "Gaseous Oxygen Compatibility Test on Moly Lube No. 99", June 11, 1963, (Doc. #99000117)
- (3) Foster, R. H., APCI Safety, Hazards, and Explosion Testing -- Epon H-60, Polycel 44OR, and Styrofoam, Lubricants, Moly Spray Kote, and Dri Lube, APCI MAR 87-0-8821, April 1962 (Doc. #99000068).
- (4) Walde, R. A., APCI Flammability and Explosion Hazards, Oxygen Pressure Gauge TWF Wool, Spintex 305, Molykote Type Z and Type X-15, APCI MAR 87-0-8822, March 1963 (Doc. #99000071).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Fluoro-glide, Chemplast Inc.

a. Specific Oxygen Environment

Gaseous oxygen, ambient temperature, pressures to 250 psig.

(1) Company Practices

- (a) Used as an alternate lubricant to fluorolubes when required for oxygen control and distribution system valve stems under conditions which warrant the use of a lubricant.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Yoder, L., Analytical Report on Flammability in 100% gaseous oxygen, 61-262, April 11, 1961, (Doc #99000139).

c. Based on Research and Development of Others

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," NASA TM X-985, p. 16, August 1964, (Doc. #99000127).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Krytox 143 AD oil (duPont)

a. Specific Oxygen Environment

Normal exposure is to air, but may be exposed to gaseous or liquid oxygen at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

(1) Company Practices

- (a) Motor Bearing lubrication for liquid oxygen pump assemblies.

B. Information Sources

1. Company Practices

b. Company Operating Experience.

Was on a trial basis for replacement of Halocarbon lubricants which do not appear to have the lubricity and mechanical properties necessary for our application. However its performance was unacceptable.

c. Based on Research and Development of Others.

- (1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, P. 12, 13, August 23, 1968, (Doc. # 99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Voltalef 3A (Kingsley and Keith Limited, U.K.)

a. Specific Oxygen Environment

Normal exposure is to air at ambient temperature, but may be exposed to gaseous or liquid oxygen, at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

(1) Company Practices (APL)

- (a) Centrifugal liquid oxygen pump drive trains bearings where intimate contact is possible.
- (b) Vertically mounted multi-stage centrifugal liquid oxygen pump drive motor bearings.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Esso Beacon 325

a. Specific Oxygen Environment

Normal exposure is to air at ambient temperature, but may be exposed to gaseous or liquid oxygen, at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

(1) Company Practices (APL)

(a) Oxygen Pump motor bearings (Byron Jackson).

(b) Cryostar direct drive pump motor bearings.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Lubricants

1. Formblin Y04 (Montecatini - Edison)

a. Specific Oxygen Environment

Normal exposure is to air at ambient temperature, but may be exposed to gaseous or liquid oxygen, at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

(1) Company Practices (APL)

- (a) This lubricant at present is being tested on a LIN pump for its lubrication properties prior to use on Centrifugal liquid oxygen pump gear box.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants & Threading Compounds

1. Permatex #1516

a. Specific Oxygen Environment

Gaseous Oxygen, Ambient Temperature to 160°F, pressure to 4500 psig.

(1) Company Practices

- (a) Centrifugal oxygen compressor, as a gasket material on the case halves of centrifugal oxygen compressors. Used in conjunction with GE RTV 60 Silicone rubber applied to the bearing portion of the case halves.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Brophy, M., Compatibility Tests with High Pressure Oxygen, R&D Notebook #111 p. 152, Jan. 1963 (Doc #99000122). The ignition bomb and test method is described in memo from E. Kehat, subject: "Development of Standard Ignition Test, Interim Report. Project No. 87-0-8820/1" Dated Nov. 17, 1961. (Doc #99000109).

b. Company Operating Experience

- (1) Satisfactory experience as a gasket material on the case halves of centrifugal oxygen compressors. Used in conjunction with GE RTV 60 Silicone rubber applied to the bearing portion of the case halves.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants & Threading Compounds

1. Teflon Tape -- Permacel

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , vacuum to 3000 psi pressures.

(1) Company Practices

- (a) All National Pipe Thread (NPT) screwed connections used in oxygen service.
- (b) APCI Design Engineering Standard 570.5.1 Nov. 1960 (Doc. #99000118).
- (c) APCI Safety Standard 609.1, June 1964 (Doc. #99000051).
- (d) APCI Safety Gram No. 27, Lubricants and Thread Components for Oxygen Systems, March 22, 1963 (Doc. #99000009).

B. Information Sources

1. Company Practices

a. Company Research.

Material tests performed by R&D on Permacel #412 Tape in 1959, no reactions in LOX bomb tests and no ignition in open flame. Mechanical performance tests at the same time indicated good acceptance for threaded joints and led to issuance of Design Engineering Standard 570.5.1 in November 1960 and Safety Standard 609.1 in June 1964. Further testing in 1936, 1964, and 1965 in a 2000 psig oxygen bomb indicated some reactions occurred. No reactions occurred when tape was thoroughly solvent cleaned prior to testing. Later solvent washings were analyzed to be hydrocarbon contaminated to an extent of 0.34 and 2.68 mg/sq. ft. of tape. Most popular brand names of tape have been tested with results similar to above tests.

- (1) Dinan, E., Jan. 28, 1959. (Doc. #99000111). Permacel Ribbon Dope, is Item 3.
- (2) Yoder, L., Analytical Report on % Hydrocarbon Contaminant, 61-3, Jan. 16, 1961 (Doc. #99000116).

- (3) Walde, R. A., "Gaseous Oxygen Compatibility of Crosslite Fluorocarbon Tape" July 30, 1963 (Doc. #99000113). Permacel Tape was compared to Crosslite Tape and 3M Fluorocarbon Tape.
- (4) Foster, R. H., APCI Safety, Hazards, and Explosion Testing Ignition Test Apparatus, Fluorlube Greases, Epoxy Compounds Devcon 2 Ton and Devcon F, Foam Type Insulations -- Styrofoam and Polyurethane Foam Insulation, Raybestos Manhattan Packing and Impregnated Asbestos Rope Material, APCI MAR 87-0-8821, February 1962 (Doc. #99000066).
- (5) Foster, R. H., APCI Safety, Hazards, and Explosion Testing -- Polyester Resin Impregnated Fiberglass Lava, APCI MAR 87-0-8821, March 1962 (Doc. #99000067).

b. Company Operating Experience.

No reactions have occurred between oxygen and teflon tape in actual operating experience. The space occupied by the teflon tape in threaded connections reduces the exposure and thereby minimizes the potential for reaction.

c. Based on Research and Development of Others.

NASA publications regarding Compatibility of Materials with Liquid Oxygen is used as a guide for selection of teflon tape, other teflon products, and other inert materials of similar formulation.

- (1) NASA-MSD, "Nonmetallic Materials Design Guide Lines and Test Data Handbook," MSD-02681, May 29, 1970 (Doc. #99000129).
- (2) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 35, December 4, 1963, (Doc. #99000128).
- (3) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," NASA TM X-53052, P. 13, May 26, 1964. (Doc. #99000124).
- (4) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III", NASA TM X-53533, p. 17, November 3, 1966, (Doc. #99000125).
- (5) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, p. 16, August 23, 1968, (Doc. #99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants & Threading Compounds

1. T-Film, Eco Mfgr. Co.

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , vacuum to 3000 psi pressure.

(1) Company Practices

- (a) On all pipe threads. Limited use, as the principal sealant is teflon tape. Used only in special applications where teflon tape has caused assembly problems. Specifically, for threaded connections in oxygen regulator assembly.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Yoder, L., Analytical Report on Flammability in 100% gaseous oxygen, Autoignition at 1 atmosphere oxygen. Sept. 18, 1961, 61-683, (Doc. #99000114).
- (2) Kehat, E., "Ignition tests of "T" Film and Penton," Nov. 28, 1961, (Doc. #99000100). 2000 psig bomb test.
- (3) Kitson, F. K., "Assembly of Oxygen Regulators" November 30, 1961. (Doc. #99000110)
- (4) Kehat, E., APCI Safety, Hazards, and Explosion Testing -- Silicon Oils, Dow Corning RF-1-0065, Silicon Oils Dow Corning RF-1-0065, Indopol Polybutene Oil Amoco L-10, Indopol Polybutene Oil Amoco H-100, Penton, T-Film Thread Compound, APCI MAR 87-0-8821, November 1961 (Doc. #9900063).

b. Company Operating Experience

Experience satisfactory, but limited.

c. Based on Research and Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 34, December 4, 1963, (Doc. #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants & Threading Compounds

1. Putti-Rope, National Greenhouse Co.

a. Specific Oxygen Environment

Exposure is normally to an inert or air atmosphere excepting when a leak in process system causes oxygen enrichment. Exposure under these conditions is gaseous or liquid oxygen. Ambient temperature to -297°F , atmospheric pressure.

(1) Company Practices

(a) Panel sealant on cold box closures.

(b) Safety standard 609.1, June 1964,
(Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Research

(1) Ent, W. L., "Putti-rope"; Analysis for Oil Content and Flammability Temperature," Dec. 11, 1959,
(Doc. #99000112).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants & Threading Compounds

1. Molylyube "N" Bel-Ray Co., Farmingdale, N. J.

a. Specific Oxygen Environment

Gaseous oxygen, ambient temperature, pressures to 3000 psig.

(1) Company Practices

- (a) Approved substitute for teflon tape on oxygen regulators where plating has reduced thread joint clearance making assembly difficult when using teflon tape.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Brophy, M., R&D Oxygen compatibility Test -- R&D Notebook #130, p. 16, 17, Feb. 11, 1963, (Doc. #99000120)

b. Company Operating Experience.

- (1) Schmoyer, W. W., "Regulator Thread Sealant", Oct. 4, 1963. (Doc. #99000119) Safety Dept. Correspondence authorizing use.

c. Based on Research & Development of Others.

- (1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, p. 14, August 23, 1968, (Doc. #99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants & Threading Compounds

1. Crosslite Fluorocarbon Tape

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , vacuum to 3000 psi pressures.

(1) Company Practices

- (a) All National Pipe Thread (NPT) screwed connections used in oxygen service.
- (b) APCI Design Engineering Standard 570.5.1 Nov. 1960 (Doc. #99000118).
- (c) APCI Safety Standard 609.1, June 1964 (Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Research.

Material tests performed by R&D on Permacel #412 Tape in 1959, no reactions in LOX bomb tests and no ignition in open flame. Mechanical performance tests at the same time indicated good acceptance for threaded joints and led to issuance of Design Engineering Standard 570.5.1 in November 1960 and Safety Standard 609.1 in June 1964. Further testing in 1936, 1964, and 1965 in a 2000 psig oxygen bomb indicated some reactions occurred. No reactions occurred when tape was thoroughly solvent cleaned prior to testing. Later solvent washings were analyzed to be hydrocarbon contaminated to an extent of 0.34 and 2.68 mg/sq. ft. of tape. Most popular brand names of tape have been tested with results similar to above tests.

- (1) Walde, R. A., "Gaseous Oxygen Compatibility of Crosslite Fluorocarbon Tape" July 30, 1963 (Doc. #99000113). Permacel Tape was compared to Crosslite Tape and 3M Fluorocarbon Tape.

b. Company Operating Experience.

No reactions have occurred between oxygen and teflon tape in actual operating experience. The space occupied by the teflon tape in threaded connections reduces the exposure and thereby minimizes the potential for reaction.

c. Based on Research and Development of Others.

NASA publications regarding Compatibility of Materials with Liquid Oxygen is used as a guide for selection of teflon tape, other teflon products, and other inert materials of similar formulation.

- (1) NASA-MSD, "Nonmetallic Materials Design Guide Lines and Test Data Handbook," MSD-02681, May 29, 1970 (Doc. #99000129).
- (2) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MFP-P&VE-M-63-14, p. 35, December 4, 1963, (Doc. #99000128).
- (3) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," NASA TM X-53052, P. 13, May 26, 1964. (Doc. #99000124).
- (4) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III", NASA TM X-53533, p. 17, November 3, 1966, (Doc. #99000125).
- (5) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, p. 16, August 23, 1968, (Doc. #99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants & Threading Compounds

1. Damco Tape

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , vacuum to 3000 psi pressures.

(1) Company Practices

(a) All National Pipe Thread (NPT) screwed connections used in oxygen service.

(b) APCI Design Engineering Standard 570.5.1 Nov. 1960 (Doc. #99000118).

(c) APCI Safety Standard 609.1, June 1964 (Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Research.

Material tests performed by R&D on Permacel #412 Tape in 1959, no reactions in LOX bomb tests and no ignition in open flame. Mechanical performance tests at the same time indicated good acceptance for threaded joints and led to issuance of Design Engineering Standard 570.5.1 in November 1960 and Safety Standard 609.1 in June 1964. Further testing in 1936, 1964, and 1965 in a 2000 psig oxygen bomb indicated some reactions occurred. No reactions occurred when tape was thoroughly solvent cleaned prior to testing. Later solvent washings were analyzed to be hydrocarbon contaminated to an extent of 0.34 and 2.68 mg/sq. ft. of tape. Most popular brand names of tape have been tested with results similar to above tests.

(1) Frederick, L. G., Analytical Report on % Ether Extractable Contaminants and Fluorescence. 70-368, Oct. 7, 1970, (Doc. #99000115).

b. Company Operating Experience.

No reactions have occurred between oxygen and teflon tape in actual operating experience. The space occupied by the teflon tape in threaded connections reduces the exposure and thereby minimizes the potential for reaction.

c. Based on Research and Development of Others.

NASA publications regarding Compatibility of Materials with Liquid Oxygen is used as a guide for selection of teflon tape, other teflon products, and other inert materials of similar formulation.

- (1) NASA-MSC, "Nonmetallic Materials Design Guide Lines and Test Data Handbook," MSC-02681, May 29, 1970 (Doc. #99000129).
- (2) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 35, December 4, 1963, (Doc. #99000128).
- (3) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," NASA TM X-53052, P. 13, May 26, 1964. (Doc. #99000124).
- (4) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III," NASA TM X-53533, p. 17, November 3, 1966, (Doc. #99000125).
- (5) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, p. 16, August 23, 1968, (Doc. #99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants & Threading Compounds

1. Sanden Tape

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , vacuum to 3000 psi pressures.

(1) Company Practices

(a) All National Pipe Thread (NPT) screwed connections used in oxygen service.

(b) APCI Design Engineering Standard 570.5.1 Nov. 1960 (Doc. #99000118).

(c) APCI Safety Standard 609.1, June 1964 (Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Research.

Material tests performed by R&D on Permacel #412 Tape in 1959, no reactions in LOX bomb tests and no ignition in open flame. Mechanical performance tests at the same time indicated good acceptance for threaded joints and led to issuance of Design Engineering Standard 570.5.1 in November 1960 and Safety Standard 609.1 in June 1964. Further testing in 1936, 1964, and 1965 in a 2000 psig oxygen bomb indicated some reactions occurred. No reactions occurred when tape was thoroughly solvent cleaned prior to testing. Later solvent washings were analyzed to be hydrocarbon contaminated to an extent of 0.34 and 2.68 mg/sq. ft. of tape. Most popular brand names of tape have been tested with results similar to above tests.

(1) Frederick, L. G., Analytical Report on % Ether Extractable Contaminants and Fluorescence. 70-368, Oct. 7, 1970, (Doc. #99000115).

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b. Company Operating Experience.

No reactions have occurred between oxygen and teflon tape in actual operating experience. The space occupied by the teflon tape in threaded connections reduces the exposure and thereby minimizes the potential for reaction.

c. Based on Research and Development of Others.

NASA publications regarding Compatibility of Materials with Liquid Oxygen is used as a guide for selection of teflon tape, other teflon products, and other inert materials of similar formulation.

- (1) NASA-MSD, "Nonmetallic Materials Design Guide Lines and Test Data Handbook," MSC-02681, May 29, 1970 (Doc. #99000129).
- (2) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 35, December 4, 1963, (Doc. #99000128).
- (3) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," NASA TM X-53052, P. 13, May 26, 1964. (Doc. #99000124).
- (4) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III," NASA TM X-53533, p. 17, November 3, 1966, (Doc. #99000125).
- (5) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, p. 16, August 23, 1968, (Doc. #99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants & Threading Compounds

1. Crane Packing Co. Tape

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , vacuum to 3000 psi pressures.

(1) Company Practices

(a) All National Pipe Thread (NPT) screwed connections used in oxygen service.

(b) APCI Design Engineering Standard 570.5.1 Nov. 1960 (Doc. #99000118).

(c) APCI Safety Standard 609.1, June 1964 (Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Research.

Material tests performed by R&D on Permacel #412 Tape in 1959, no reactions in LOX bomb tests and no ignition in open flame. Mechanical performance tests at the same time indicated good acceptance for threaded joints and led to issuance of Design Engineering Standard 570.5.1 in November 1960 and Safety Standard 609.1 in June 1964. Further testing in 1936, 1964, and 1965 in a 2000 psig oxygen bomb indicated some reactions occurred. No reactions occurred when tape was thoroughly solvent cleaned prior to testing. Later solvent washings were analyzed to be hydrocarbon contaminated to an extent of 0.34 and 2.68 mg/sq. ft. of tape. Most popular brand names of tape have been tested with results similar to above tests.

(1) Frederick, L. G., Analytical Report on % Ether Extractable Contaminants and Fluorescence. 70-368, Oct. 7, 1970, (Doc. #99000115).

b. Company Operating Experience.

No reactions have occurred between oxygen and teflon tape in actual operating experience. The space occupied by the teflon tape in threaded connections reduces the exposure and thereby minimizes the potential for reaction.

c. Based on Research and Development of Others.

NASA publications regarding Compatibility of Materials with Liquid Oxygen is used as a guide for selection of teflon tape, other teflon products, and other inert materials of similar formulation.

- (1) NASA-MSD, "Nonmetallic Materials Design Guide Lines and Test Data Handbook," MSC-02681, May 29, 1970 (Doc. #99000129).
- (2) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 35, December 4, 1963, (Doc. #99000128).
- (3) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," NASA TM X-53052, P. 13, May 26, 1964. (Doc. #99000124).
- (4) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III", NASA TM X-53533, p. 17, November 3, 1966, (Doc. #99000125).
- (5) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, p. 16, August 23, 1968, (Doc. #99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants & Threading Compounds

1. Oxomat

a. Specific Oxygen Environment

Gaseous oxygen, ambient temperature, pressures to 3000 psig.

(1) Company Practices

- (a) Used as an alternate thread sealant in applications where teflon tape is not satisfactory. Approval from Safety Dept. is required in each specific application.

B. Information Sources

1. Company Practices

a. Company Research

Moysan, S. R., Analytical Report on Flammability in 100% gaseous oxygen, 61-435, June 6, 1961, (Doc. #99000121). Autoignition test in oxygen.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants & Threading Compounds

1. 3M Fluorocarbon Tape

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , vacuum to 3000 psi pressures.

(1) Company Practices

- (a) All National Pipe Thread (NPT) screwed connections used in oxygen service.
- (b) APCI Design Engineering Standard 570.5.1 Nov. 1960 (Doc. #99000118).
- (c) APCI Safety Standard 609.1, June 1964 (Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Research.

Material tests performed by R&D on Permacel #412 Tape in 1959, no reactions in LOX bomb tests and no ignition in open flame. Mechanical performance tests at the same time indicated good acceptance for threaded joints and led to issuance of Design Engineering Standard 570.5.1 in November 1960 and Safety Standard 609.1 in June 1964. Further testing in 1936, 1964, and 1965 in a 2000 psig oxygen bomb indicated some reactions occurred. No reactions occurred when tape was thoroughly solvent cleaned prior to testing. Later solvent washings were analyzed to be hydrocarbon contaminated to an extent of 0.34 and 2.68 mg/sq. ft. of tape. Most popular brand names of tape have been tested with results similar to above tests.

- (3) Walde, R. A., "Gaseous Oxygen Compatibility of Crosslite Fluorocarbon Tape" July 30, 1963 (Doc. #99000113). Permacel Tape was compared to Crosslite Tape and 3M Fluorocarbon Tape.

b. Company Operating Experience.

No reactions have occurred between oxygen and teflon tape in actual operating experience. The space occupied by the teflon tape in threaded connections reduces the exposure and thereby minimizes the potential for reaction.

c. Based on Research and Development of Others.

NASA publications regarding Compatibility of Materials with Liquid Oxygen is used as a guide for selection of teflon tape, other teflon products, and other inert materials of similar formulation.

- (1) NASA-MSD, "Nonmetallic Materials Design Guide Lines and Test Data Handbook," MSD-02681, May 29, 1970 (Doc. #99000129).
- (2) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 35, December 4, 1963, (Doc. #99000128).
- (3) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," NASA TM X-53052, P. 13, May 26, 1964. (Doc. #99000124).
- (4) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III", NASA TM X-53533, p. 17, November 3, 1966, (Doc. #99000125).
- (5) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, p. 16, August 23, 1968, (Doc. #99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Sealants and Threading Compounds

1. Sodium Silicate and China Clay Paste

a. Specific Oxygen Environment

Liquid and gaseous oxygen -300°F to $+320^{\circ}\text{F}$, pressures up to 600 PSIG.

(1) Company Practices

(a) Horizontal split seals on oxygen turbo compressor (G.H.H. Design).

(b) Valve bonnets.

(c) Valve seat threads.

B. Information Sources

1. Company Practices (APL)

b. Used in the above duties for several years without incident.

c. Based on Research and Development of Others

Recommended by British Cryogenics Council's Cryogenic Safety Manual, A Guide to Good Practice, 1970, London, Great Britain, (Doc. #99000359).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Thermal & Electrical Insulations

1. Foamglas (cellular glass) Insulation, Pittsburgh-Corning Corp.

a. Specific Oxygen Environment

Normal exposure is to air, but may be exposed to gaseous or liquid oxygen at ambient temperatures -297°F and atmospheric pressure in the event of process leak. Also exposure may be to liquid air in the event of insulation-breakdown.

(1) Company Practices

(a) Thermal insulation for oxygen transmission lines.

(b) Thermal insulation for any line operating at cryogenic temperatures below the liquefaction temperature of air.

(c) APCI Safety Standard 609.1, page 5, June 1964, (Doc. 99000051).

(d) APL Engineering Specification N.05, Rev. 0, January 2, 1970 (Doc. #99000381).

B. Information Sources

1. Company Practices

a. Company Research

(1) Yoder, L., Analytical Report on Flammability in 100% gaseous oxygen, 61-34 to 61-40 and 61-42, February 3, 1961, (Doc. #99000130).

c. Based on Research and Development of Others.

(1) Key, C. D. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 36, December 4, 1963, (Doc. #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Thermal & Electrical Insulations

1. Transite, Johns-Manville

a. Specific Oxygen Environment

Normal exposure is to inert or air atmosphere excepting when a leak in process system causes oxygen enrichment. Exposure under these conditions is gaseous or liquid oxygen, ambient temperature to -297°F , atmospheric pressure.

(1) Company Practices

(a) Cold box vessel supports needed for shipping and not as structural supports. A replacement for wooden supports.

(b) APCI Safety Standard 609.1, page 5, June 1964. (Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Research

(1) Bauer, E., "Behavior of Transite Under Compressive Loads at Ambient and Liquid N_2 Temperatures" APCI TR #53, August 1962, (Doc. #99000134).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Thermal & Electrical Insulations

1. Glass Wool

s. Specific Oxygen Environment

Normal exposure is to inert or air atmosphere excepting when a leak in process system causes oxygen enrichment. Exposure under these conditions is gaseous or liquid oxygen, ambient temp. to -297°F , atmospheric pressure.

(1) Company Practices

- (a) Thermal insulation in cold boxes.
- (b) APCI Design Engineering Standard 581.3, Oct. 24, 1960. (Doc. #99000041).
- (c) APCI Safety Standard 609.1, p. 4, June 1964. (Doc. #99000051).
- (d) Batch analysis for oil content required on every shipment per QCL 103L. (Doc. #99000131). Maximum allowed oil contamination is 3.5 lbs. per ton of glass wool.

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 38, December 4, 1963, (Doc. #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Thermal & Electrical Insulations

1. Mineral Wool

a. Specific Oxygen Environment

Normal exposure is to inert or air atmosphere excepting when a leak in process system causes oxygen enrichment. Exposure under these conditions is gaseous or liquid oxygen, ambient temp. to -297°F and atmospheric pressure.

(1) Company Practices

(a) Thermal Insulation for cold boxes.

(b) APCI Safety Standard 609.1, p. 4, June 1964 (Doc. #99000051).

(c) APCI Design Engineering Standard 581.2, June 26, 1969, (Doc. #99000040).

(d) Batch analysis for oil content required on every shipment of Rockwool per QCL 103L. (Doc. #99000131). Maximum allowable oil contamination is 3.5 lbs. per ton of mineral wool.

(e) APL Engineering Specification N.02, Rev. 0, January 2, 1970 (Doc. #99000380).

B. Information Sources

1. Company Practices

a. Company Research

(1) Himmelberger, F. "Quality Control of Rockwool" November 6, 1959. (Doc. #99000145).

(2) Bassler, E. "Production of Rockwool - Bethlehem Steel Company," November 12, 1959, (Doc. #99000147).



c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 38, December 4, 1963, (Doc. #99000128).
- (2) Matthews, W. D., and G. G. Owen, ICI Ltd, "Safety Aspects of Reconstructed ICI Oxygen Plant", AIChE, Safety in Air and Ammonia Plants, Vol. 5, p. 11, 1963. (Doc. #99000103).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Thermal & Electrical Insulations

1. Perlite

a. Specific Oxygen Environment

Normal exposure is to inert or air atmosphere excepting where a leak in process system causes oxygen enrichment. Exposure under these conditions is gaseous or liquid oxygen, ambient temp. to -297°F and atmospheric pressure.

(1) Company Practices

- (a) Thermal insulation for cold boxes.
- (b) APCI Design Engineering Standard 581.1, May 26, 1961. (Doc. #99000039).
- (c) APCI Safety Standard 609.1, p. 4, June 1964. (Doc. #99000051).
- (d) APL Engineering Specification N.01, Rev. 0, January 2, 1970 (Doc. #99000379).
- (e) Campbell, R. W. and B. W. Taylor, Use of Perlite in Air Separation Cold Boxes, APCI TB 39, June 14, 1971 (Doc. #99000038).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Thermal & Electrical Insulations

1. Milfoam -- Milfoam Corporation

a. Specific Oxygen Environment

Normal exposure is to air, but may be exposed to gaseous or liquid oxygen at ambient temperatures to -297°F and atmospheric pressure in the event of a process leak. Also, exposure may be to liquid air in the event of insulation breakdown.

(1) Company Practices

(a) Thermal insulation for oxygen transmission lines as an alternate material for Foamglas under conditions where Foamglas is used 5 feet on either side of a leak potential joint (flange, valve, etc.)

(b) APCI memorandum, Kitson, F. K., Insulation Materials for Cryogenic Systems, November 1, 1968 (Doc. #99000292).

B. Information Sources

1. Company Practices

a. Company Research

(1) APCI memorandum, Schmauch, G., Flammability Tests on Insulation, October 24, 1968 (Doc. #99000293).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Thermal & Electrical Insulations

1. National Gypsum Blue - National Gypsum Corporation

a. Specific Oxygen Environment

Normal exposure is to air, but may be exposed to gaseous or liquid oxygen at ambient temperatures to -297°F and atmospheric pressure in the event of a process leak. Also, exposure may be to liquid air in the event of insulation breakdown.

(1) Company Practices

(a) Thermal insulation for oxygen transmission lines as an alternate material for Foamglas under conditions where Foamglas is used 5 feet on either side of a leak potential joint (flange, valve, etc.) with the balance of the insulation as National Gypsum Blue.

(b) APCI memorandum, Kitson, F. K., Insulation Materials for Cryogenic Systems, November 1, 1968 (Doc. #99000292).

B. Information Sources

1. Company Practices

a. Company Research

(1) APCI memorandum, Schmauch, G., Flammability Tests on Insulation, October 24, 1968 (Doc. #99000293).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Plastics, Elastomers, and Adhesives

1. RTV-60, Silicone Rubber Compound with SS-4004 silicone primer, G. E. Thermolite-12 curing catalyst.

- a. Specific Oxygen Environment

Gaseous oxygen, ambient temperature, atmospheric pressure to 450 psig.

- (1) Company Practices

- (a) Centrifugal Oxygen Compressors. Used only at the bearing area of centrifugal oxygen compressor case halves where there is a continuous exposure to oxygen leaks through labyrinth seals.

B. Information Sources

1. Company Practices

- a. Company Research

- (1) Brophy, M., R&D High Pressure Oxygen Compatibility Test. R&D Notebook #111, p. 149, Jan. 1963, (Doc. #99000137). Ignition was obtained only with the sample in direct contact with the ignition wire at 100 and 2000 psi.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Plastics, Elastomers, and Adhesives

1. Keene Binder

a. Specific Oxygen Environment

No direct exposure to gaseous or liquid oxygen exists in normal use excepting where leakage from process system is possible or breaks in the insulation permit liquefaction of air on cold surfaces then the exposure is to gaseous and liquid oxygen at -297°F and atmospheric pressure or oxygen enriched gaseous or liquid air at temperatures below -297°F and atmospheric pressure.

(1) Company Practices

(a) An inorganic cement type binder used as an adhesive for sealing joints between cellular glass foam line insulating material.

(b) APCI Safety Standard 609.1, page 5, June 1964, (Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Research

It is believed that this material was tested for flammability, however no test records could be found.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Plastics, Elastomers, and Adhesives

1. Kel-F 81

a. Specific Oxygen Environment

Gaseous oxygen ambient temperature pressures to 3000 psig.

(1) Company Practices

(a) Regulator seats

(b) Selected cylinder valve seats

B. Information Sources

1. Company Practices

a. Company Research

(1) Walde, R. A., "Kel-F High Pressure Oxygen Compatibility," May 17, 1963, (Doc. #99000132). The Kel-F in these tests was shredded giving results which were not in agreement with results of other testing agencies.

c. Based on Research and Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 45, December 4, 1963, (Doc. #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Plastics, Elastomers, and Adhesives

1. Nylon

a. Specific Oxygen Environment

Gaseous oxygen, ambient temperature, pressures to 3000 psig.

(1) Company Practices

Nylon is not entirely compatible in oxygen service, gaseous and liquid. However successful performance history with relatively few failures in the past 25 years is the reason why nylon continues to be used in high pressure oxygen service to 3000 psig as cylinder valve seats and regulator seats.

(a) H.P. regulator seats

(b) Oxygen cylinder valve seats

B. Information Sources

1. Company Practices

a. Company Research

(1) Yoder, L., Analytical Report on Ignition Temperature in 100% oxygen Atmosphere, 60-496, Jan. 6, 1961. (Doc. #99000133).

(2) Walde, R. A., "Kel-F High Pressure Oxygen Compatibility", May 17, 1963, (Doc. #99000132). Comparison tests with Kel-F.

b. Company Operating Experience.

Nylon is not entirely compatible in oxygen service, gaseous and liquid. However successful performance history with relatively few failures in the past 25 years is the reason why nylon continues to be used in high pressure oxygen service to 3000 psig as cylinder valve seats and regulator seats.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Plastics, Elastomers, and Adhesives

1. Neoprene

a. Specific Oxygen Environment

Gaseous oxygen, ambient temperature, pressures to 3000 psig.

(1) Company Practices.

Neoprene is not entirely compatible in oxygen service, however satisfactory performance over last 25 years permits neoprene to remain in low pressure oxygen service. Its principal use is in oxygen regulators where the exposure is to normally less than 50 psig oxygen.

(a) Regulator safety valve stem seats

(b) Regulator diaphragms with neoprene molded on brass parts.

(c) "O" rings

(d) High pressure seats in two stage regulators.

B. Information Sources

1. Company Practices

b. Company Operating Experience.

(1) Neoprene is not entirely compatible in oxygen service, however satisfactory performance over last 25 years permits neoprene to remain in low pressure oxygen service. Its principal use is in oxygen regulators where the exposure is to normally less than 50 psig oxygen.

c. Based on Research & Development of Others.

(1) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III," NASA TM X-53533, p. 31, November 3, 1966, (Doc. #99000125).

(2) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV," NASA TM X-53773, p. 25, August 23, 1968, (Doc. #99000126).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Plastics, Elastomers, and Adhesives

1. Viton A, duPont

a. Specific Oxygen Environment

Gaseous oxygen ambient temperature to 160°F, pressures to 250 psig.

(1) Company Practices

(a) Soft seating faces of butterfly valves in oxygen compressor systems.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Brophy, M., "Safety Tests Under WO 81-0095", April 27, 1966. (Doc. #99000135). Oxygen bomb tests to 250 psig. Hylomar Unward Jointing compound SQ-32 was rejected under the same test.
- (2) Frederick, L. G., and D. R. Latshaw, Oxygen Index Rating Viton O-Ring Material, Viton E-60 (Green), Viton A (Black), Garlock 900 Johns Manville Asbestos 61 Sheet, APCI Analytical Report 71-344, APCI Analytical Report 71-345, August 13, 1971 (Doc. #99000304).
- (3) Nissler, K. H., Demag KA-27-IV/KA-4-IV Oxygen Compressor Viton A (Black), Viton E-60 (Green), Demag Letter to APCI, August 11, 1971 (Doc. #99000305).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 58, December 4, 1963, (Doc. #99000128).
- (2) Key, C. F. NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III," NASA TM X-53533, p. 38, November 3, 1966, (Doc. # 99000125).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Plastic, Elastomers and Adhesives

1. Nylon 66' (I.C.I. Limited, U.K.)

a. Specific Oxygen Environment

Gaseous oxygen, ambient temperature, pressures up to 3000 psig.

(1) Company Practices (APL)

(a) H.P. Regulator Seats

(b) Oxygen Cylinder Valve Seats

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packings

1. Graphite Impregnated Asbestos Packing.

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to
-297°F, atmospheric pressure to 3000 psig.

(1) Company Practices

(a) Packing for high pressure reciprocating
liquid oxygen pumps

(b) Stem packing for various valves in oxygen
service.

B. Information Sources

1. Company Practices

a. Company Research

(1) Ball, W.L., "Combustible Contaminant Content in
Graphite Impregnated Asbestos Packing." Sept. 30,
1960., (Doc. #99000144).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packings

1. TFE-GF-Green, Melrath Gaskets Co.

a. Specific Oxygen Environment

Liquid oxygen -297°F. Pressures to 250 psig.

(1) Company Practices

(a) Gaskets in LOX transfer hose connections

B. Information Sources

1. Company Practices

a. Company Research

(1) Kitson, F., "Flammability Test of Gaskets in Oxygen Atmospheres," Oct. 23, 1970, (Doc. #99000146).
Material glowed and charred but did not burst into flame.

b. Company Operating Experience.

(1) This material similar to Fluorogreen E-600.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packings

1. Vallegreen, Valley Forge Gasket Co.

a. Specific Oxygen Environment

Liquid oxygen, -297°F, pressures to 250 psig.

(1) Company Practices

(a) Gaskets in LOX transfer hose connections

B. Information Sources

1. Company Practices

a. Company Research

(1) Kitson, F., "Flammability Test of Gaskets in Oxygen Atmospheres," Oct. 23, 1970, (Doc. #99000146).
Material glowed and charred but did not burst into flame.

b. Company Operating Experience.

(1) This material similar to Fluorogreen E-600.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packings

1. Fluorogreen E-600, John Dore Company

a. Specific Oxygen Environment

Liquid Oxygen, -297°F, Pressures to 250 psig.

(1) Company Practices

(a) Gaskets in LOX transfer hose connections.

B. Information Sources

1. Company Practices

a. Company Research

(1) Kitson, F., "Flammability Test of Gaskets in Oxygen Atmospheres," Oct. 23, 1970, (Doc. #99000146).
Material glowed and charred but did not burst into flame.

c. Based on Research & Development of Others.

(1) Key, C.F., and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 62, December 4, 1963, (Doc. #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packings

1. Melrath 150 -- sheet asbestos gasket material,
Melrath Gasket Co.

- a. Specific Oxygen Environment

Gaseous and liquid oxygen ambient temperature to
-297°F, Pressures to 250 psig.

- (1) Company Practices

- (a) Flange gasket connections on oxygen
vaporizers

B. Information Sources

1. Company Practices

- a. Company Research

- (1) Frederick, L. G., Analytical Report on the Compati-
bility of Melrath Material with Oxygen, 70-026,
January 30, 1970. (Doc. #99000141).

- b. Company Operating Experience.

As an alternate for Garlock 900.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packings

1. KM226 Sheet asbestos gasket material, Nicolet Industries Inc.

a. Specific Oxygen Environment

Gaseous and liquid oxygen ambient temperature to -297°F
Pressures to 250 psig.

(1) Company Practices

(a) Flange gasket connections on oxygen
vaporizers.

B. Information Sources

1. Company Practices

a. Company Research

(1) Frederick, L. G., Analytical Report on the Compati-
bility of Gasket Materials with Oxygen, 70-014,
January 30, 1970. (Doc. #99000142).

b. Company Operating Experience.

As an alternate for Garlock 900.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packings

1. Garlock 900, sheet asbestos gasket material, Garlock Mfg. Co.

a. Specific Oxygen Environment

Gaseous and liquid oxygen, 160°F to -297°F, pressures to 600 psig.

(1) Company Practices

(a) Most flange gaskets in air separation plants and in oxygen lines.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Frederick, L. G., Analytical Report on the Compatibility of Gasket Materials with Oxygen, 70-013, January 30, 1970, (Doc. #99000141 or 99000142).
- (2) Frederick, L. G., and D. R. Latshaw, Oxygen Index Rating Viton O-Ring Material, Viton E-60 (Green), Viton A (Black), Garlock 900 Johns Manville Asbestos 61 Sheet, APCI Analytical Report 71-344, APCI Analytical Report 71-345, August 13, 1971 (Doc. #99000304).
- (3) Nissler, K. H., Demag KA-27-IV/KA-4-IV Oxygen Compressor Viton A (Black), Viton E-60 (Green), Demag Letter to APCI, August 11, 1971 (Doc. #99000305).
- (4) Frederick, L. G., and D. R. Latshaw, Compatibility of Material with Oxygen, Johns Manville Asbestos Sheet Packing Style No. 61, Garlock 900, APCI IWO LB-0795, APCI Analytical Report 71-264, May 28, 1971 (Doc. #99000309).
- (5) Robinson, G. W., APCI LOX Compatible Gasket Materials, Garlock 900 Durabla Johns-Manville Asbestos Sheet Packing Style 61, APCI Memo dated June 2, 1971 (Doc. #99000310).

b. Company Operating Experiences.

The gasket is not completely compatible with oxygen, however, 25 years of incident free successful service warrants its use in low risk applications.

- (1) Key, C. F., and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 62, December 4, 1963, (Doc. #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packings

1. Vulcanized Red Fibre Gaskets

a. Specific Oxygen Environment

Exposure is to air at ambient temperature and atmospheric pressure excepting if leak in system develops, then exposure is to gaseous oxygen at ambient temperature and atmospheric pressure.

(1) Company Practices

- (a) Oxygen cylinder valve part not exposed to oxygen except on failure of system.

B. Information Sources

1. Company Practices

a. Company Research

Limited to hydrocarbon analysis for hazard evaluation.

- (1) Moysan, S. R., Analytical Report on Qualitative and Quantitative Oil Analysis, 63-1662, 63-1663, November 6, 1963, (Doc. #99000143).

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LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packings

1. KM246 sheet asbestos gasket material - Nicolet Industries

a. Specific Oxygen Environment

Gaseous and liquid oxygen ambient temperature to -297°F ,
Pressures to 250 psig.

(1) Company Practices

(a) Flange gasket connections on oxygen vaporizers

B. Information Sources

1. Company Practices

a. Company Research

(1) Frederick, L. G., Analytical Report on the Compatibility of Gasket Materials with Oxygen, 70-015, January 30, 1970, (Doc. #99000142).

b. Company Operating Experience.

As an alternate for Garlock 900.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packings

1. Teflon, duPont

a. Specific Oxygen Environment

Gaseous and liquid oxygen, 100°F to -297°F, pressures to 3000 psig.

(1) Company Practices

(a) Oxygen cylinder valve and manifold shut-off valve stem packing.

(b) Stem packing in various valves in oxygen production compression, distribution, and control systems.

(c) APL Engineering Specification L.14, Rev. 0, July 8, 1969 (Doc. #99000377).

B. Information Sources

1. Company Practices

a. Company Research

The evaluation of teflon tape applies to packing material as well.

(1) Dinan, E., Jan. 28, 1959. (Doc. #99000111).
Permacel Ribbon Dope, is Item 3.

(2) Yoder, L., Analytical Report on % Hydrocarbon Contaminant, 61-3, Jan. 16, 1961, (Doc. #99000116).

(3) Walde, R. A., "Gaseous Oxygen Compatibility of Crosslite Fluorocarbon Tape" July 30, 1963, (Doc. #99000113). Permacel Tape was compared to Crosslite Tape and 3M Fluorocarbon Tape.

- (4) Geist, J. M., Controlled Kinetics Experimentation --
Teflon Hose, APCI MAR 87-0-8820, May 1960
(Doc. #99000057).
- (5) Geist, J. M., Controlled Kinetics Experiments --
Teflon Hoses, Supported by Braided Stainless Steel
Housing, and Rubber Hoses, Plasite No 7122H, APCI
MAR 87-0-8820, June 1960, (Doc. #99000058).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compati-
bility of Materials with Liquid Oxygen,"
MTP-P&VE-M-63-14, p. 54, December 4, 1963,
(Doc. #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packings

1. Viton A, duPont

a. Specific Oxygen Environment

Gaseous oxygen, ambient temperature to 160°F, pressures to 250 psig.

(1) Company Practices

(a) Flange gaskets for piping systems

(b) "O" ring packings for valves

B. Information Sources

1. Company Practices

a. Company Research

- (1) Brophy, M., "Safety Tests Under W081-0095" April 27, 1966. (Doc. #99000135). Oxygen bomb tests to 250 psig.
- (2) Frederick, L. G., and D. R. Latshaw, Oxygen Index Rating Viton O-Ring Material, Viton E-60 (Green), Viton A (Black), Garlock 900 Johns Manville Asbestos 61 Sheet, APCI Analytical Report 71-344, APCI Analytical Report 71-345, August 13, 1971 (Doc. #99000304).
- (3) Nissler, K. H., Demag KA-27-IV/KA-4-IV Oxygen Compressor Viton A (Black), Viton E-60 (Green), Demag Letter to APCI, August 11, 1971 (Doc. #99000305).

c. Based on Research & Development of Others.

- (1) Key, C.F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 58, December 4, 1963, (Doc. #99000128).
- (2) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III," NASA TM X-53533, p. 38, November 3, 1966, (Doc. #99000125).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packing

1. Sindanyo. CS 51 Asbestos and Cement Boards. Natural untreated finish (Turners Asbestos Cement Co. Ltd. U.K.).

- a. Specific Oxygen Environment

Normal exposure is to air or nitrogen, but may be exposed to gaseous or liquid oxygen at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

- (1) Company Practices (APL)

- (a) Cold Pipe Support Insulating and Packing material.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packing

1. Klingerit 661 (Richard Klinger Limited U.K.)

a. Specific Oxygen Environment

Gaseous and liquid oxygen systems, 160°F to -297°F
and pressures up to 600 psig.

(1) Company Practices (APL)

- (a) All flange gaskets in air separation plants and
in oxygen lines

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Gaskets and Packing

1. Tygaflo cementable PTFE tapes (Tygadure Limited U.K.).

a. Specific Oxygen Environment

Normal exposure is to air, but may be exposed to gaseous or liquid oxygen at ambient temperature to -297°F and atmospheric pressure in the event of a process leak.

(1) Company Practices (APL).

- (a) APL have used these tapes to provide a low friction joint between two metallic faces of a penetration plate so that pipe stresses could be minimized.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Tarsset - Pittsburgh Chemical Co.

a. Specific Oxygen Environment

Exposure is to air excepting where leakage from system occurs. Exposure is then to gaseous oxygen at ambient temperature and atmospheric pressure.

(1) Company Practices

(a) Underground transmission line coating.

(b) APCI Safety Standard 609.1, p. 3, June 1964, (Doc. #99000051).

(c) This is an alternate coating material to Plasite.

B. Information Sources

1. Company Practices

a. Company Research

(1) Brophy, M., R&D Tarsset Burning Tests, R&D Notebook #111, p. 129-132, July 1962, (Doc. #99000149).

(2) Brophy, M., R&D Pipe Burning Tests, R&D Notebook #111, p. 26-29, April 1961, (Doc. #99000148).

(3) Foster, R. H., Safety Hazards, and Explosion Testing, APCI Monthly Activities Report, 87-0-8821, July 1962, (Doc. #99000070).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Sealfas Mastic #31-97, Benjamin Foster Co.

a. Specific Oxygen Environment

Exposure is to air excepting where leakage from process system occurs. Exposure then is to gaseous or liquid oxygen, ambient temperature to -297°F , and atmospheric pressure.

(1) Company Practices

(a) A sealant for thermal insulation on product transmission lines operating at a temperature below the liquefaction temp. of air.

(b) APCI Safety Standard 609.1, p. 5, June 1964, (Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Research

(1) Yoder, L., Analytical Report on Flammability in 100% gaseous oxygen, 61-38, 61-39, Feb. 3, 1961, (Doc. #99000130).

c. Based on Research & Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 37, December 4, 1963, (Doc. #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Plasite, No. 7122H, Wisconsin Protective Coating Co.

a. Specific Oxygen Environment

Exposure is to air excepting where leakage from process system occurs. Exposure then is to gaseous or liquid oxygen, ambient temperature to -297°F , and atmospheric pressure.

(1) Company Practices

(a) Underground transmission line coating.

(b) Above ground insulated transmission line coating.

(c) APCI Safety Standards 609.1, p. 3, June 1964, (Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Research

(1) Brophy, M. "Plasite Protective Coating," June 9, 1960, (Doc. #99000150). Corrosion resistance and flammability of coated surfaces tests.

(2) Geist, J. M., Controlled Kinetics Experiments -- Teflon Hoses, Supported by Braided Stainless Steel Housing, and Rubber Hoses, Plasite No. 7122H, APCI MAR 87-0-8820, June 1960, (Doc. #99000058).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Copper Pipe ASTM B42

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F ,
pressure to 3000 psig

(1) Company Practices

(a) Various components of oxygen plant piping
systems, and instrument systems.

(b) Design Engineering Standard 574.1, p. 3,
May 1962, (Doc. #99000161).

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

(1) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense
Metals Information Center, Battelle Memorial
Institute, "Reactivity of Metals with Liquid and
Gaseous Oxygen," DMIC Memorandum 163, p. 12,
January 15, 1963, (Doc. #99000152).

(2) White, E. L., and J. J. Ward, Defense Metals Informa-
tion Center, Battelle Memorial Institute, "Ignition
of Metals in Oxygen," DMIC Report 224, p. 14,
February 1, 1966, (Doc. #99000153).

(3) Dean, L. E. and W. R. Thompson, Aerojet-General,
"Ignition of Metals and Alloys," American Rocket
Society Journal, p. 917-923, July 1961,
(Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Copper tube ASTM B75

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 2300 psig.

(1) Company Practices

- (a) Interconnecting pipe systems in oxygen plants
- (b) Design Engineering Standard 574.1, May 1962, (Doc. #99000161).
- (c) Design Engineering Standard 574.2, Jan. 1964, (Doc. #99000162).
- (d) Design Engineering Standard 574.10, Jan. 1964, (Doc. #99000163).
- (e) Design Engineering Standard 574.50, Nov. 1968, (Doc. #99000164).
- (f) Design Engineering Standard 574.51, Nov. 1968, (Doc. #99000165).
- (g) Design Engineering Standard 574.52, April 1967, (Doc. #99000166).
- (h) Design Engineering Standard 574.54, Jan. 1964, (Doc. #99000167).

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

- (1) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 12, January 15, 1963, (Doc. #99000152).

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- (2) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 14, February 1, 1966, (Doc. #99000153).
- (3) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Red Brass Pipe ASTM B43

a. Specific Oxygen Environment

Gaseous oxygen, ambient temperature, pressures to 3000 psig.

(1) Company Practices

(a) Piping headers for gaseous oxygen filling and discharging cylinder manifolds.

(b) Design Engineering Standard 572.1, p. 1, May, 1962, (Doc. 99000151).

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

(1) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).

(2) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 14, February 1, 1966, (Doc. #99000153).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Aluminum ASTM B211 2024-T4

a. Specific Oxygen Environment

Exposure is to air excepting where leakage from process system occurs. Exposure then is to gaseous or liquid oxygen, ambient temperature to -297°F, and atmospheric pressure.

(1) Company Practices

(a) Flange bolting and studs.

(b) Design Engineering Standard 571.2, Nov. 1967, (Doc. #99000156).

(c) Design Engineering Standard 571.3, Nov. 1967, (Doc. #99000157).

(d) Design Engineering Standard 571.4, Nov. 1967, (Doc. #99000158).

(e) The references listed below in most tests for compatibility list aluminum without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 66, 67, December 4, 1963, (Doc. #99000128).

- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 12, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Aluminum, ASTM B 210 3003

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 900 psig.

(1) Company Practices

- (a) Straight aluminum instrument tubing, 3/8" O.D. x .035" wall, ASTM 3003-H14.
- (b) Coiled aluminum instrument tubing, 3/8" O.D. x .035" wall, ASTM 3003-0.
- (c) Design Engineering Standard 571.50, Nov. 1968, (Doc. #99000159).
- (d) Design Engineering Standard 571.51, Nov. 1968, (Doc. #99000160).
- (e) The references listed below in most tests for compatibility list aluminum without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 66, 67, December 4, 1963, (Doc. #99000128).

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IA6a-8 (Continued)

- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 12, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Aluminum ASTM B209 5083-0

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 150 psig.

(1) Company Practices

(a) Plant piping sizes 14" through 36"

(b) Fittings for pipe sizes 14" through 36"

(c) Design Engineering Standard 571.2, Oct. 1965, (Doc. #99000155).

(d) Design Engineering Standard 571.3, Nov. 1967, (Doc. #99000156).

(e) The references listed below in most tests for compatibility list aluminum without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MFP-P&VE-M-63-14, p. 66, 67, December 4, 1963, (Doc. #99000128).

- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 12, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

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IA6a-10

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Aluminum, ASTM B210 6061-T6

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 900 psig.

(1) Company Practices

- (a) Instrument tubing 3/8" O.D. x .065" wall is mandatory for analyzer taps.
- (b) Design Engineering Standard 571.50, Nov. 1968, (Doc. #99000159).
- (c) Design Engineering Standard 571.51, Nov. 1968, (Doc. #99000160).
- (d) The references listed below in most tests for compatibility list aluminum without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 66, 67, December 4, 1963, (Doc. #99000128).
- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).

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IA6a-10 (Continued)

- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 12, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Aluminum ASTM B241 6061-T6

a. Specific Oxygen Environment

Gas and liquid oxygen, ambient temperature to -297°F , pressures to 300 psig.

(1) Company Practices

(a) Piping systems to 12" diameter

(b) Design Engineering Standard 571.3, November 1967, (Doc. #99000157).

(c) Design Engineering Standard 571.4, November 1967, (Doc. #99000158).

(d) The references listed below in most tests for compatibility list aluminum without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 66, 67, December 4, 1963, (Doc. #99000128).

(2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).

- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 12, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Aluminum ASTM B247 6061-T6

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 3000 psig.

(1) Company Practices

- (a) Anodized body, bonnet, and backcaps of regulators to 3000 psig.
- (b) Forged flanges for interconnecting plant aluminum piping to 300 psig.
- (c) Forged fittings for interconnecting plant aluminum piping to 300 psig.
- (d) Design Engineering Standard 571.2, November 1967, (Doc. #99000156).
- (e) Design Engineering Standard 571.3, November 1967, (Doc. #99000157).
- (f) Design Engineering Standard 571.4, November 1967, (Doc. #99000158).
- (g) The references listed below in most tests for compatibility list aluminum without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 66, 67, December 4, 1963, (Doc. #99000128).

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IA6a-12 (continued)

- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 12, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Aluminum B361 WP6061-T6

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 300 psig

(1) Company Practices

(a) Wrought butt weld fittings to 12 in. pipe size for plant piping systems.

(b) Design Engineering Standard 571.3, November 1967, (Doc. #99000157).

(c) Design Engineering Standard 571.4, November 1967, (Doc. #99000158).

(d) The references listed below for most tests for compatibility list aluminum without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 66, 67, December 4, 1963, (Doc. #99000128).

(2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).

- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 12, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Carbon Steel - (Oxygen Service)

a. Specific Oxygen Environment

Gaseous oxygen, -20°F to 100°F, pressures to about 3000 psig.

(1) Company Practices

- (a) Transmission lines and interconnecting piping using ASTM A53, A53GrB, A134GrA, A135GrA, A245GrA, or A283GrA material.
- (b) Fittings for transmission lines using ASTM A105Gr2 and A234 WPB or WPA material
- (c) Gaseous oxygen cylinders of D.O.T. specified steels at pressures to 3000 psig and temperatures of -20°F to 130°F.
- (d) Safety relief valve springs in cold gas service at ambient temperatures down to -320°F and pressures to 160 psig.
- (e) Design Engineering Standard 578.10.1, Oct. 1965, (Doc. #99000168).
- (f) Design Engineering Standard 578.10.2, Oct. 1966, (Doc. #99000169).
- (g) Design Engineering Standard 578.10.3, June 1962, (Doc. #99000170).
- (h) Design Engineering Standard 578.10.4, Jan. 1964, (Doc. #99000171).
- (i) Design Engineering Standard 578.10.5, Jan. 1964, (Doc. #99000172).
- (j) Design Engineering Standard 578.10.6, June 1962, (Doc. #99000173).
- (k) Design Engineering Standard 578.60.3, Sept. 1969, (Doc. #99000030).

- (l) Design Engineering Standard 578.60.4, Sept. 1969
(Doc. #99000031).
- (m) Design Engineering Standard 578.60.5, Sept. 1969,
(Doc. #99000032).
- (n) Design Engineering Standard 578.60.6, Sept. 1969,
(Doc. #99000033).
- (o) The references listed below in most tests for
compatibility list steel or steel alloys without
identifying ASTM number or grades. However,
we interpret the references as being applicable
to the various ASTM numbers and grades as a
class.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Foster, R. H., "Cold Test of 1/2" Safety Valve with
Carbon Steel Spring, W.O. #10-7071, Project
00-5-3246-51.12" Technical Memorandum No. 79,
April 27, 1965, (Doc. #99000185).
- (2) Kehat, E., "Burning of Steel Pipes in a Flowing
Oxygen Stream." April 17, 1961, (Doc.
#99000186).
- (3) Bailey, B., "Ignition Limits of Carbon Steel in
Oxygen-Nitrogen Atmospheres", IWO LB-0043, APCI
Technical Memorandum No. 112, May 8, 1968,
(Doc. #99000187).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compati-
bility of Materials with Liquid Oxygen,"
MTP-P&VE-M-63-14, p. 69, December 4, 1963,
(Doc. #99000128).
- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense
Metals Information Center, Battelle Memorial
Institute, "Reactivity of Metals with Liquid and
Gaseous Oxygen," DMIC Memorandum 163, p. 23,
January 15, 1963, (Doc. #99000152).

- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 921, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Stainless Steel ASTM A312 TP304

a. Specific Oxygen Environment

Gaseous and Liquid Oxygen, ambient temperature to -297°F
pressures to 3000 psig.

(1) Company Practices

- (a) Piping systems at oxygen compressors as dictated by conditions of installation
- (b) Instrument piping above 1500 psig
- (c) Lubricating oil piping in bearing areas of centrifugal oxygen compressors. Exposure is to air excepting where leakage from system occurs.
- (d) Design Engineering Standard 578.30.1, May 1962, (Doc. #99000174).
- (e) Design Engineering Standard 578.30.2, November 1967, (Doc. #99000175).
- (f) Design Engineering Standard 578.30.3, November 1967, (Doc. #99000176).
- (g) Design Engineering Standard 578.30.4, January 1964, (Doc. #99000177).
- (h) Design Engineering Standard 578.30.5, January 1964, (Doc. #99000178).
- (i) Design Engineering Standard 578.30.6, January 1964, (Doc. #99000179).
- (j) Design Engineering Standard 578.30.8, January 1964, (Doc. #99000180).
- (k) Design Engineering Standard 578.30.15, November 1967, (Doc. #99000181).
- (l) Design Engineering Standard 578.40.1, September 1969, (Doc. #99000182).

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IA6a-15 (Continued)

- (m) The references listed below in most tests for compatibility list stainless steel without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Bailey, B., "Ignition Limits of Some Stainless Steels in an Oxygen Atmosphere." Project 00-7-3480-51.00, APCI Technical Memorandum No. 114, (Doc. #99000188).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 69, 70, December 4, 1963, (Doc. #99000128).
- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 921, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Stainless Steel ASTM A240 304

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F
pressures to 3000 psig

(1) Company Practices

- (a) Inner vessel of cryogenic storage tanks, highway tankers and railroad tankers.
- (b) Structural support members of internal components of air separation plant cold boxes. Exposure is to air or inert gas excepting where leaks in system occur.
- (c) Medium pressure liquid oxygen dewars.
- (d) The references listed below in most tests for compatibility list stainless steel without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Bailey, B., "Ignition Limits of Some Stainless Steels in an Oxygen Atmosphere." Project 00-7-3480-51.00, APCI Technical Memorandum No. 114, (Doc. #99000188).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 69, 70, December 4, 1963, (Doc. #99000128).

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IA6a-16 (continued)

- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 921, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Stainless Steel ASTM A403 WP304 and A403 WP304L.

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 3000 psig

(1) Company Practices

- (a) Wrought stainless fittings for piping systems.
- (b) Design Engineering Standard 578.30.1, May 1962, (Doc. #99000174).
- (c) Design Engineering Standard 578.30.2, November 1967, (Doc. #99000175).
- (d) Design Engineering Standard 578.30.3, November 1967, (Doc. #99000176).
- (e) Design Engineering Standard 578.30.4, January 1964, (Doc. #99000177).
- (f) Design Engineering Standard 578.30.5, January 1964, (Doc. #99000178).
- (g) Design Engineering Standard 578.30.6, January 1964, (Doc. #99000179).
- (h) Design Engineering Standard 578.30.8, January 1964, (Doc. #99000180).
- (i) Design Engineering Standard 578.30.15, November 1967, (Doc. #99000181).
- (j) Design Engineering Standard 578.40.1, September 1969, (Doc. #99000182).
- (k) The references listed below in most tests for compatibility list stainless steel without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Bailey, B., "Ignition Limits of Some Stainless Steels in an Oxygen Atmosphere." Project 00-7-3480-51.00, APCI Technical Memorandum No. 114, (Doc. #99000188).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 69, 70, December 4, 1963, (Doc. #99000128).
- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 921, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Stainless steel ASTM A320 B8304

a. Specific Oxygen Environment

Exposure is to air excepting where leakage from system occurs. Exposure then is to gaseous or liquid oxygen, ambient temperature to -297°F , and atmospheric pressure.

(1) Company Practices

- (a) Bolting and studs used with forged flanges in piping systems for liquid and gaseous oxygen.
- (b) Design Engineering Standard 578.30.1, May 1962, (Doc. #99000174).
- (c) Design Engineering Standard 578.30.2, November 1967, (Doc. #99000175).
- (d) Design Engineering Standard 578.30.3, November 1967, (Doc. #99000176).
- (e) Design Engineering Standard 578.30.4, January 1964, (Doc. #99000177).
- (f) Design Engineering Standard 578.30.5, January 1964, (Doc. #99000178).
- (g) Design Engineering Standard 578.30.6, January 1964, (Doc. #99000179).
- (h) Design Engineering Standard 578.30.8, January 1964, (Doc. #99000180).
- (i) Design Engineering Standard 578.30.15, November 1967, (Doc. #99000181).
- (j) Design Engineering Standard 578.40.1, September 1969, (Doc. #99000182).
- (k) The references listed below in most tests for compatibility list stainless steel without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Bailey, B., "Ignition Limits of Some Stainless Steels in an Oxygen Atmosphere." Project 00-7-3480-51.00, APCI Technical Memorandum No. 114, (Doc. #99000188).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 69, 70, December 4, 1963, (Doc. #99000128).
- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 926, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Stainless Steel ASTM A194 8T321

a. Specific Oxygen Environment

(1) Company Practices

- (a) Flange nuts in piping systems for liquid and gaseous oxygen.
- (b) Design Engineering Standard 578.30.1, May 1962, (Doc. #99000174).
- (c) Design Engineering Standard 578.30.2, November 1967, (Doc. #99000175).
- (d) Design Engineering Standard 578.30.3, November 1967, (Doc. #99000176).
- (e) Design Engineering Standard 578.30.4, January 1964, (Doc. #99000177).
- (f) Design Engineering Standard 578.30.5, January 1964, (Doc. #99000178).
- (g) Design Engineering Standard 578.30.6, January 1964, (Doc. #99000179).
- (h) Design Engineering Standard 578.30.8, January 1964, (Doc. #99000180).
- (i) Design Engineering Standard 578.30.15, November 1967, (Doc. #99000181).
- (j) Design Engineering Standard 578.40.1, September 1969, (Doc. #99000182).
- (k) The references listed below in most tests for compatibility list stainless steel without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Bailey, B., "Ignition Limits of Some Stainless Steels in an Oxygen Atmosphere." Project 00-7-3480-51.00, APCI Technical Memorandum No. 114, (Doc. #99000188).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 69, 70, December 4, 1963, (Doc. #99000128).
- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 921, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Stainless steels, type 416 cadmium plated

a. Specific Oxygen Environment

Gaseous oxygen, ambient temperature, pressure to 3000 psig.

(1) Company Practices

(a) Oxygen cylinder valve stem tang.

(b) The references listed below in most tests for compatibility list stainless steel without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

a. Company Research

(1) Bailey, B., "Ignition Limits of Some Stainless Steels in an Oxygen Atmosphere." Project 00-7-3480-51.00, APCI Technical Memorandum No. 114, (Doc. #99000188).

c. Based on Research & Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 69, 70, December 4, 1963, (Doc. #99000128).

(2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).

(3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).

(4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 921, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Stainless Steel ASTM A182 F 304 and ASTM A182 F 316

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 3000 psig.

(1) Company Practices

- (a) Forged fittings for piping systems.
- (b) Tube adaptors in instrument piping service
- (c) Design Engineering Standard 578.30.1, May 1962, (Doc. #99000174).
- (d) Design Engineering Standard 578.30.2, November 1967, (Doc. #99000175).
- (e) Design Engineering Standard 578.30.3, November 1967, (Doc. #99000176).
- (f) Design Engineering Standard 578.30.4, January 1964, (Doc. #99000177).
- (g) Design Engineering Standard 578.30.5, January 1964, (Doc. #99000178).
- (h) Design Engineering Standard 578.30.6, January 1964, (Doc. #99000179).
- (i) Design Engineering Standard 578.30.8, January 1964, (Doc. #99000180).
- (j) Design Engineering Standard 578.30.15, November 1967, (Doc. #99000181).
- (k) Design Engineering Standard 578.40.1, September 1969, (Doc. #99000182).
- (1) The references listed below in most tests for compatibility list stainless steel without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Bailey, B., "Ignition Limits of Some Stainless Steels in an Oxygen Atmosphere." Project 00-7-3480-51.00, APCI Technical Memorandum No. 114, (Doc. #99000188).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MFP-P&VE-M-63-14, p. 69, 70, December 4, 1963, (Doc. #99000128).
- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Stainless Steel, type 304, unidentified as to ASTM spec.

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 3000 psig.

(1) Company Practices

- (a) Sintered filters, high pressure oxygen regulators
- (b) Springs, nozzles, stems, pins, and seat retainers in oxygen regulators.
- (c) Shafts, rods, and specific parts for reciprocating and centrifugal oxygen pumps and compressors.
- (d) Forged and cast stainless steel valve bodies
- (e) Forged, cast, and machined stainless steel valve trim.
- (f) Bourdon tubes in special gauges.
- (g) Design Engineering Standard 578.60.1, p. 2, April 1971, (Doc. #99000028).
- (h) Design Engineering Standard 531.2, p. 3, Oct. 1963, (Doc. #99000022).
- (i) Design Engineering Standard 579.31., May 1964, (Doc. #99000034).
- (j) Design Engineering Standard 579.15, August 1966, (Doc. #99000037).
- (k) The references listed below in most tests for compatibility list stainless steel without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Bailey, B., "Ignition Limits of Some Stainless Steels in an Oxygen Atmosphere." Project 00-7-3480-51.00, APCI Technical Memorandum No. 114, (Doc. #99000188).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 69, 70, December 4, 1963, (Doc. #99000128).
- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Copper-Silicon ASTM B98GrB

a. Specific Oxygen Environment

Exposure is to air excepting where leakage from system occurs. Exposure then is to gaseous or liquid oxygen, ambient temperature to -297°F , and atmospheric pressure.

(1) Company Practices

(a) As bonnet bolts, studs, and nuts for various valve bodies or assemblies.

(b) The references listed below in most tests for compatibility list metals without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

b. Company Operating Experience

(1) Acceptable material through years of successful service.

c. Based on Research & Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, December 4, 1963, (Doc. #99000128).

(2) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," NASA TM X-985, August 1964 (Doc. #99000127).

(3) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen", NASA TM X-53052, May 26, 1964, (Doc. #99000124).

- (4) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III", NASA TM X-53533, November 3, 1966, (Doc. #99000125).
- (5) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV", NASA TM X-53773, August 23, 1968, (Doc. #99000126).
- (6) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, January 15, 1963, (Doc. #99000152).
- (7) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, February 1, 1966, (Doc. 99000153).
- (8) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Free Machining Brass

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F, pressures to 3000 psig.

(1) Company Practices

(a) Regulator inlet, outlet, gages, and misc. parts.

(b) Oxygen Cyl. valve parts - packing nut, stem body, stem pin, plug, safety nut, handwheel nut. Some parts exposed to oxygen only when leak in systems occur.

(c) Valve trim.

(d) The references listed below in most tests for compatibility list metals without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

b. Company Operating Experience

(1) Accepted material through years of successful service.

c. Based on Research & Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, December 4, 1963, (Doc. #99000128).

(2) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," NASA TM X-985, August 1964, (Doc. #99000127).

- (3) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen", NASA TM X-53052, May 26, 1964, (Doc. #99000124).
- (4) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, III", NASA TM X-53533, November 3, 1966, (Doc. #99000125).
- (5) Key, C. F., NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen, IV", NASA TM X-53773, August 23, 1968, (Doc. #99000126).
- (6) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, January 15, 1963, (Doc. #99000152).
- (7) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, February 1, 1966, (Doc. 99000153).
- (8) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Beryllium Copper

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 3600 psig

(1) Company Practices

- (a) Bourdon tubes in pressure gauges above 800 psig.
- (b) Rupture discs in oxygen cylinder valves.
- (c) Inlet and outlet valves on some reciprocating liquid oxygen pumps.
- (d) Design Engineering Standard 531.2, p. 3, Oct. 1963, (Doc. #99000022).
- (e) The references listed below in most tests for compatibility list metals without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 67, December 4, 1963, (Doc. #99000128).
- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).

- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 14, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Stainless Steel ASTM A269 304

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F pressures to 3000 psig.

(1) Company Practices

(a) Tubing in storage vessel piping systems.

(b) The references listed below in most tests for compatibility list stainless steel without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

a. Company Research

(1) Bailey, B., "Ignition Limits of Some Stainless Steels in an Oxygen Atmosphere." Project 00-7-3480-51.00, APCI Technical Memorandum No. 114, (Doc. #99000188).

c. Based on Research & Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 69, 70, December 4, 1963, (Doc. #99000128).

(2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000153).

- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Bronze ASTM B61 or B62

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 3000 psig.

(1) Company Practices

- (a) Valve bodies and valve trim for pipe line, oxygen compressor, and air separation plants.
- (b) Sintered bronze filters in regulator inlet connections.
- (c) Design Engineering Standard 579.3, Jan. 1963, (Doc. #99000183). (Specification for various valves used in systems)
- (d) The references listed below in most tests for compatibility list metals without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 67, December 4, 1963, (Doc. #99000128).
- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).

- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 14, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Brass sheet or plate, ASTM B36

a. Specific Oxygen Environment

Gaseous oxygen, ambient temperatures, pressures to 1500 psig.

(1) Company Practices

(a) Impingement plates in carbon steel oxygen transmission lines where flow is into the side of a fabricated tee in lines larger than 6" in diameter.

(b) Design Engineering Standard 578.60.3, Note 3, September 1969, (Doc. #99000030).

(c) The references listed below in most tests for compatibility list metals without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 67, December 4, 1963, (Doc. #99000128).

(2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).

- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 14, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Monel, ASTM B164

a. Specific Oxygen Environment

Gaseous or liquid oxygen, ambient temperature to -279°F , pressures to 3000 psig.

(1) Company Practices

- (a) Tees used in carbon steel oxygen lines up to 6" in diameter where the flow is into the side port.
- (b) Piping downstream of some pressure control valves in critical velocity areas.
- (c) Valve forgings in critical velocity areas of oxygen transmission systems.
- (d) Reciprocating liquid oxygen pump rods.
- (e) Suction strainers for oxygen compressors.
- (f) Valve trim in critical velocity areas of oxygen transmission lines.
- (g) Design Engineering Standard 578.60.3, Note 3,
- (h) The references listed below in most tests for compatibility list metals without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

- c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 67, 68, December 4, 1963, (Doc. #99000128).
- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 14, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Stainless Steel ASTM A351 Gr CF8

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient temperature to -297°F , pressures to 1500 psig.

(1) Company Practices

- (a) Cast stainless steel valve bodies and valve trim in specified applications in oxygen systems.
- (b) Design Engineering Standard 579.3, Jan. 1963, (Doc. #99000183). (Specification for various valves used in systems.)
- (c) The references listed below in most tests for compatibility list stainless steel without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Bailey, B., "Ignition Limits of Some Stainless Steels in an Oxygen Atmosphere." Project 00-7-3480-51.00, APCI Technical Memorandum No. 114, (Doc. #99000188).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 69, 70, December 4, 1963, (Doc. #99000128).

- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Stainless, 9% Nickel Steel, ASTM A353GB

a. Specific Oxygen Environment

Gaseous and liquid oxygen ambient temperature to -297°F , pressures to 250 psig.

(1) Company Practices

(a) Inner vessel of cryogenic liquid storage containers.

(b) The references listed below in most tests for compatibility list stainless steel without identifying ASTM number or grades. However, we interpret the references as being applicable to the various ASTM numbers and grades as a class.

B. Information Sources

1. Company Practices

a. Company Research

(1) Bailey, B., "Ignition Limits of Some Stainless Steels in an Oxygen Atmosphere." Project 00-7-3480-51.00, APCI Technical Memorandum No. 114, (Doc. #99000188).

c. Based on Research & Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 69, 70, December 4, 1963, (Doc. #99000128).

- (2) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 23, January 15, 1963, (Doc. #99000152).
- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Copper Tube ASTM B88

a. Specific Oxygen Environment

Gaseous and liquid oxygen, ambient Temperature to -297°F , pressures to 900 psig.

(1) Company Practices

- (a) Interconnecting pipe systems in oxygen plants
- (b) Design Engineering Standard 574.1, May 1962, (Doc. #99000161).
- (c) Design Engineering Standard 574.2, Jan. 1964, (Doc. #99000162).
- (d) Design Engineering Standard 574.10, Jan. 1964, (Doc. #99000163).
- (e) Design Engineering Standard 574.50, Nov. 1968 (Doc. #99000164).
- (f) Design Engineering Standard 574.51, Nov. 1968 (Doc. #99000165).

B. Information Sources

1. Company Practices

c. Based on Research & Development of Others.

- (1) Jackson, J. D., W. K. Boyd, and P. D. Miller, Defense Metals Information Center, Battelle Memorial Institute, "Reactivity of Metals with Liquid and Gaseous Oxygen," DMIC Memorandum 163, p. 12, January 15, 1963, (Doc. #99000152).
- (2) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 14, February 1, 1966, (Doc. 99000153).
- (3) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Carbon Steel - (Non Oxygen Service with possible exposure to oxygen).

a. Specific Oxygen Environment

Exposure is to air excepting where leakage from system occurs. Exposure is then to gaseous oxygen at ambient temperature and atmospheric pressure.

(1) Company Practices

- (a) Flanges of ASTM A181 Gr 1 material in transmission and piping systems
- (b) Studs of ASTM A193 Gr B7 or A307GrB material
- (c) Nuts of ASTM A194 GrH material
- (d) Oxygen regulator adjusting springs and spring buttons.
- (e) Outer shells of storage tanks and highway tankers of ASTM A7 material
- (f) Design Engineering Standard 578.10.2, October 1966, (Doc. #99000169).
- (g) Design Engineering Standard 578.10.3, June 1962, (Doc. #99000170).
- (h) Design Engineering Standard 578.10.4, January 1964, (Doc. #99000171).
- (i) Design Engineering Standard 578.10.5, January 1964, (Doc. #99000172).
- (j) Design Engineering Standard 578.10.6, June 1962, (Doc. #99000173).
- (k) Design Engineering Standard 578.10.9, June 1962 (Doc. #99000184).
- (l) Design Engineering Standard 578.60.3, September 1969, (Doc. #99000030).

- (m) Design Engineering Standard 578.60.4,
September 1969, (Doc. #99000031).
- (n) Design Engineering Standard 578.60.5,
September 1969, (Doc. #99000032).
- (o) Design Engineering Standard 578.60.6,
September 1969, (Doc. #99000033).
- (p) The references listed below in most tests for
compatibility list steel or steel alloys with-
out identifying ASTM number or grade. However,
we interpret the references as being applicable
to the various ASTM numbers and grades as a
class.

B. Information Sources

1. Company Practices

a. Company Research

- (1) Foster, R. H., "Cold Test of 1/2" Safety Valve with
Carbon Steel Spring, W.O. #10-7071, Project
00-5-3246-51.12" Technical Memorandum No. 79,
April 27, 1965, (Doc. #99000185).
- (2) Kehat, E., "Burning of Steel Pipes in a Flowing
Oxygen Stream." April 17, 1961, (Doc. #99000187).
- (3) Bailey, B., "Ignition Limits of Carbon Steel in
Oxygen-Nitrogen Atmospheres", IWO LB-0043, APCI
Technical Memorandum No. 112, May 8, 1968,
(Doc. #99000187).
- (4) Kehat, E., APCI Safety, Hazards and Explosion Testing
Ucon Type Lubricants, Steel Pipes, APCI MAR 87-0-8820,
April, 1961 (Doc. #99000059).

c. Based on Research & Development of Others.

- (1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compati-
bility of Materials with Liquid Oxygen,"
MTP-P&VE-M-63-14, p. 69, 70, December 4, 1963,
(Doc. #99000128).
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Institute, "Reactivity of Metals with Liquid and
Gaseous Oxygen," DMIC Memorandum 163, p. 23,
January 15, 1963, (Doc. #99000152).

- (3) White, E. L., and J. J. Ward, Defense Metals Information Center, Battelle Memorial Institute, "Ignition of Metals in Oxygen," DMIC Report 224, p. 15, February 1, 1966, (Doc. 99000153).
- (4) Dean, L. E. and W. R. Thompson, Aerojet-General, "Ignition of Metals and Alloys," American Rocket Society Journal, p. 917-923, July 1961, (Doc. #99000154).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Spheroidal graphite Iron (Continental standard GGG 38).

a. Specific Oxygen Environment

Gaseous oxygen, ambient to 320°F, pressure up to
600 PSIG

(1) Company Practices (APL)

(a) High Pressure casing for O₂ Turbo Compressors.

(b) Cylinder heads and jackets for High Pressure
O₂ Reciprocating Compressors.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Silver

a. Specific Oxygen Environment

Gaseous oxygen, ambient to 320°F pressures up to
600 PSIG.

(1) Company Practices (APL)

(a) Oxygen turbo compressor labyrinths.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Novonox Stainless steel alloy
To DIN (German National Standards), Composition:
5% Cr, 17% Ni, 4% Cu, Niobium Stabilizer, balance Fe.

- a. Specific Oxygen Environment

Gaseous oxygen, ambient to 320°F, pressures up to
600 PSIG.

- (1) Company Practices (APL)

- (a) Oxygen turbo - compressor Impellers.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Muntz Metal 60/40 Type, Composition: Cu 58 - 61%,
Zn 38.5 - 42%, Pb 0.35 - 0.9%

- a. Specific Oxygen Environment

Gaseous oxygen, ambient to 320°F pressures up to
600 PSIG.

- (1) Company Practices (APL)

- (a) Oxygen Turbo compressor
Cooler tube plates

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Metals, alloys, solders, and surface treatments

1. Alpha brass tube Type TCL 100 or DTD 5019
(Tungum Company Limited U.K.).
Composition: Copper 86%, Alum. 1.2%, Nickel 1.4%
Silicon 1.3%, Iron 0.25%, Lead .05%, Tin 0.1%,
Manganese 0.1%. Total other impurities 0.5%, Zinc
Remainder.

a. Specific Oxygen Environment

Gaseous and liquid oxygen, 100°F to -297°F, pressures
up to 3000 PSIG.

(1) Company Practices (APL)

(a) Oxygen manifold piping

(b) Oxygen bottling facilities

(c) Small standard plant cold box piping

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Chemicals, solvents, and miscellaneous

1. 1,1, dichloroethane

a. Specific Oxygen Environment

None. Exposure may be to gaseous or liquid oxygen, ambient temperature to -297°F , pressures to 300 psig if solvent is not completely removed from equipment or parts before introducing to oxygen service.

(1) Company Practices

(a) Solvent agent for hydrocarbon decontamination of small parts used in oxygen systems.

B. Information Sources

1. Company Practices

a. Company Research

(1) Kehat, E., "Development of Standard Ignition Test Progress Report -- Project #87-0-8821", dated Jan. 3, 1962, (Doc. #99000136).

(2) Bassler, E., "Cleaning for Oxygen Service" Jan. 1960, (Doc. #99000096).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Chemicals, solvents, and miscellaneous

1. 1,1,1, Trichloroethane

a. Specific Oxygen Environment

None. Exposure may be to gaseous or liquid oxygen, ambient temperature to -297°F , pressures to 3000 psi if solvent is not completely removed from equipment or parts before introducing to oxygen service.

(1) Company Practices

(a) Solvent agent for hydrocarbon decontamination of small parts used in oxygen systems.

(b) Safety Standard 609.1, page 2, June 1964, (Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Practices

(1) Kehat, E., "Development of Standard Ignition Test Progress Report -- Project #87-0-8821," dated Jan. 3, 1962, (Doc. #99000136).

(2) Bassler, E., "Cleaning for Oxygen Service" Jan. 1960, (Doc. #99000096).

c. Based on Research and Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 78, December 4, 1963, (Doc. #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Chemicals, solvents, and miscellaneous

1. Chloroform

a. Specific Oxygen Environment

None. Exposure may be to gaseous or liquid oxygen, ambient temperature to -297°F , pressures to 300 psi if solvent is not completely removed from equipment or parts before introducing to oxygen service.

(1) Company Practices

(a) Solvent agent acceptable for hydrocarbon decontamination of small parts used in oxygen systems.

(b) Laboratory applications

B. Information Sources.

1. Company Practices

a. Company Research

(1) Kehat, E., "Development of Standard Ignition Test Progress Report -- Project #87-0-8821," dated Jan. 3, 1962, (Doc. #99000136).

(2) Bassler, E., "Cleaning for Oxygen Service," Jan. 1960, (Doc. #99000096).

c. Based on Research and Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 78, December 4, 1963, (Doc. #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Chemicals, solvents, and miscellaneous

1. Carbon Tetrachloride

a. Specific Oxygen Environment

None. Exposure may be to gaseous oxygen ambient temperature, and atmospheric pressure if solvent is not completely removed from equipment or parts before introducing to oxygen service.

(1) Company Practices

(a) Use of carbon tetrachloride prohibited in all areas of activity excepting as authorized in certain laboratory applications.

(b) Safety Gram No. 68, Carbon Tetrachloride, Feb. 21, 1969, (Doc. #99000106).

B. Information Sources

1. Company Practices

a. Company Research

(1) Kehat, E., "Development of Standard Ignition Test Progress Report -- Project #87-0-8821," dated Jan. 3, 1962, (Doc. #99000136).

(2) Bassler, E., "Cleaning for Oxygen Service" Jan. 1960, (Doc. #99000096).

c. Based on Research and Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 78, December 4, 1963, (Doc. #99000128).

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LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Chemicals, solvents, and miscellaneous

1. Trichloroethylene

a. Specific Oxygen Environment

None. Exposure may be to gaseous or liquid oxygen, ambient temperature to -297°F , pressures to 3000 psig if solvent is not completely removed from equipment or parts before introducing to oxygen service.

(1) Company Practices

(a) Solvent agent for hydrocarbon decontamination of small parts used in oxygen systems.

(b) Safety Standard 609.1, page 2, June 1964.
(Doc. # 99000051).

B. Information Sources.

1. Company Practices

a. Company Research

(1) Kehat, E., "Development of Standard Ignition Test Progress Report -- Project #87-0-8821," dated Jan. 3, 1962, (Doc. #99000136).

(2) Bassler, E., "Cleaning for Oxygen Service" Jan. 1960, (Doc. #99000096).

c. Based on Research and Development of Others.

(1) Key, C. F. and W. A. Riehl, NASA-GCMSFC, "Compatibility of Materials with Liquid Oxygen," MTP-P&VE-M-63-14, p. 81, December 4, 1963, (Doc. #99000128).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

A. Chemicals, solvents, and miscellaneous

1. Methylene Chloride

a. Specific Oxygen Environment

None. Exposure may be to gaseous or liquid oxygen, ambient temperature to -297°F , pressures to 3000 psi if solvent is not completely removed for equipment or parts before introducing to oxygen service.

(1) Company Practices

(a) Air Separation plant wash-out solvent

(b) Solvent agent for decontamination of small parts used in oxygen systems.

(c) Safety Standard 609.1, page 2, June 1964, (Doc. #99000051).

B. Information Sources

1. Company Practices

a. Company Research

(1) Kehat, E., "Development of Standard Ignition Test Progress Report -- Project #87-0-8821," dated Jan. 3, 1962, (Doc. #99000136).

(2) Bassler, E., "Cleaning for Oxygen Service" Jan. 1960, (Doc. #99000096).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

B. Compatibility Check

1. Fire Compatibility

c. Cleaning Procedures

In the cleaning of commercial cryogenic systems, the primary task is to remove those contaminants (such as oil and grease) which create a hazardous condition when oxygen is present. A secondary consideration is the removal of those contaminants which might interfere with operation. Examples of this latter category are particles of grit which can interfere with valve closure, and water which can plug up equipment as it freezes.

Before a system is put in service, a cleaning step takes place in the blowing out of all lines, valves, and packing glands. Heated, dry oil-free air or nitrogen is used for blowing out. To be dry oil-free air, it has to go through a drier and have a dew point of -40°F . Nitrogen is preferred. Despite all reasonable precautions during original cleaning and fabrication, it is surprising to observe the amount of foreign material which is blown out in this manner.

After equipment has been in operation, periodic cleaning is necessary only if it becomes contaminated with a fuel. Normally, this does not occur, but if inspections or evidence of contamination indicate fuel to be present in an oxygen system, prompt cleaning of operating equipment is mandatory. Industrial frequency of inspection, and cleaning of operating equipment varies from annually to never, if there is no specific cause for suspecting contamination.

I Cleaning Procedures

A. Company Practices

1. Initial installation-Construction

a. Carbon steel pipe 3" and larger

- (1) Sand blast to remove rust, varnish and mill scale and other foreign matter.
- (2) Immerse in a solution to provide an alkaline activated coating to the surface of the work to act as a temporary rust inhibitor.

b. Carbon steel pipe 2 1/2" and smaller

- (1) Immerse in a hot solution with a stripper additive to remove varnish and initiate action on rust and scale.
- (2) Remove pipe - thoroughly rinse with water.
- (3) Immerse again in a hot solution to assure complete removal of rust and scale.
- (4) Remove pipe from cleaning solution and rinse with water.
- (5) Immerse in a solution to provide an alkaline activated coating to the surface of the work to act as a temporary rust inhibitor.

c. Carbon steel pipelines

- (1) Pipe must be supplied with no interior varnish.
- (2) Temporary spool pieces and cleaning stations are used to permit specified in place cleaning and inspection.
- (3) The interior of all pipe is sand blast cleaned in place by the Klean Kote Inc. method (Kleane Kote Inc. P.O. Box 588, LaPorte, Texas).
- (4) The pipe is blown out with dry, oil free air or nitrogen after it is blast cleaned.

d. Aluminum, stainless steel, and copper pipe

- (1) Immerse in the proper hot solution and allow to soak in solution for a period of time required for complete removal of soils and contaminants.
- (2) Rinse in water using a high velocity stream.

e. Fabricated pipe spools after cleaning shall be capped. Pipelines after cleaning are kept under slight positive nitrogen pressure.

2. Existing Installation-Operations

- a. Frequency of cleaning is depending on the following:
 - (1) Periodic inspections when normal preventive

maintenance is scheduled.

- (2) Product sample analysis indicating contaminants.
- (3) Normal schedule as determined from past experience.
- (4) Abnormal operating conditions, such as, high pressure drops, valve seat leakage, etc.

b. Types of Cleaning

- (1) Flushing normally used on complex piping circuits. This method is considered the most practical way to clean a cryogenic piping system that has previously been in service.

The piping prior to using the flushing method must be checked to insure that all low points have suitable drains. The high points need vents to completely fill circuits. Double block and bleed valves are necessary where solution could enter an undesirable circuit.

It is first necessary to warm a system prior to flushing. This is done by blowing the system out using 110°F to 150°F nitrogen or dry oil-free air until the insulation and piping are warm, and then use 90°F nitrogen or dry oil-free air to insure that the whole system is not warmer than 90°F. Normally all relief valves and instrument lines are removed and valves are installed to control flow.

Flushing will require a suitable pump for introducing and recirculating the cleaning solution. Although experience has proven that recirculation is not entirely necessary, it is preferred. If it is not possible to recirculate the solution, it is necessary to allow the solution to remain in the system for one hour. The solution when drained, will be replaced with fresh solvent if appreciably discolored, and reintroduced in the system for another soak. When using the soak or recirculating procedure, it must be kept in mind that all circuits must be

completely filled with solution.

Air Products and Chemicals uses methylene chloride for flushing solution. Samples are used to determine the magnitude of contamination. Samples of unused and used solution are gathered for comparison analysis. The quantity of solution introduced along with the quantity that is drained must be recorded to get an indication of how much solution is left in the system. Then other means such as pressurization are used to remove the remaining solution. The total contamination level is based on the sample analysis and the quantity of solution introduced in the system.

The circuits are again blown out after the cleaning solution has been drained. When methylene chloride is used, the circuits are heated to 150°F. and held at this temperature for approximately four hours.

- (2) Immersion for small items that are easily accessible.

This method is commonly used as a quick job site emergency method, such as when small parts of a valve are replaced while the system is temporarily shut down. This cleaning usually only requires a clean bucket and a source of nitrogen or dry oil-free air for blowing parts dry.

Methylene chloride or trichlorethylene are the types of cleaning solutions APCI most commonly used for quick cleaning of small parts.

The immersion method is also used extensively for cleaning pipe fittings during initial construction phase. This type of cleaning uses one of the many types of detergent solutions. The type of detergent solution is dependent on the metal to be cleaned.

- (3) Spraying or swabbing of large vessels that can be entered.

Surfaces may be sprayed with cleaning solution

applied by pressure spray nozzles. This method is used for cleaning tanks when convenient access is available.

Spraying and swabbing is used at times to clean pipes, fittings, and certain parts.

The spraying and swabbing cleaning method can use a chlorinated solvent or a detergent solution depending on the type of metal as well as the size of the area to be cleaned.

- (4) Vacuuming used to clean out loose particles prior to a more thorough cleaning.
- (5) Blow-out - most commonly used method when dry oil-free air or nitrogen is available. Vacuuming and Blow-out method discussion.

Vacuum cleaning loose particles, introduced during fabrication, is used when ready access to the surface is possible.

Inaccessible surfaces on systems and/or circuits may be blown free of solid particles. Sufficient velocity and volume shall be provided to accomplish thorough removal of loose particles from both the system and its outlets. Blow-out using nitrogen or dry oil-free air is done prior to most cleaning procedures. It is also used after cleaning with solutions to remove all traces of solvents or detergents that could not be drained. In most blow-outs, the nitrogen or air is heated to about 10-50°F above the boiling point of the cleaning solution, to assist in complete derime of system.

- (6) Vapor cleaning - this is a commercial method requiring special equipment.

Small items may be cleaned in commercial vapor cleaning equipment. Assemblies which contain removable parts shall be disassembled for vapor cleaning.

This type of cleaning is used commonly by suppliers of parts for oxygen compressors, pumps, valves, etc. This cleaning procedure will supply APCI AAA standard cleanliness. (1,2)

c. Degree of cleanliness

- (1) APCI Class AA cleanliness (3,4) is for fixed surfaces that come in contact with pure oxygen. It will meet the following requirements.
 - (a) Visual examination of the direct surface under strong white light shall indicate: no moisture, slag, organic material, or other foreign material, and essentially no corrosion products.
 - (b) Particulate matter will not exceed 1000 microns and will amount to less than 10 particles between 500 and 1000 microns.
 - (c) Black light examination shall indicate no hydrocarbon fluorescence. Isolated particles of lint may be acceptable.
 - (d) A wipe test, shall show no appreciable discoloration and no evidence of oily residue.
- (2) Class AAA cleanliness (1,2) is for movable parts such as valves, pumps, etc. that come in direct contact with pure oxygen. Requirements are the same as for Class AA with the following additions:
 - (a) Particulate contamination will be limited to 500 microns with not more than 25 particles between 175 and 500 microns.
 - (b) Isolated particles of lint detected by black light must be removed with nitrogen or dry oil-free air.

3. Types of Cleaning Solution

a. Detergents:

(1) Soil and Oil Removal:

- (a) Ferrous metals (including stainless steel, invar, and nine-nickel)

#77 Oakite
J.S.T.C. Johar
#4 Johar (low foaming)

(b) Aluminum and Aluminum Alloys

#77 Oakite
J.S.T.C. Johar
#4 Johar

(2) Rust and Scale Removal

(a) Ferrous Metals

#32 Oakite (Hydrochloric base)
Oakite Rust Stripper (Removes paint
and varnish)
#13 Johar

(b) All Metals

#31 Oakite (removes oxides and fluxes)
#23 Johar

(3) Deoxidizer and Brightener

(a) Aluminum and Copper

#34M Oakite (Chromic base)
#22 Johar

(4) Rust Retardant

(a) All Metals

Rinsite (also prevents water spotting)

(5) Corrosion Stain Removal

(a) Aluminum and Aluminum Alloys

#160 Oakite (etching material) rinses freely
#21 Johar

Detergent solutions shall not be employed to clean a surface which, through use, will contact oxygen rich atmospheres, unless the cleaned surface can definitely be determined as free of all cleaning solution after rinse.

b. Chlorinated Solvents

(1) Removal of oil, grease, fats, waxes, tar, rubber, sulfur, and resins.

(a) All Metals

Trichlorethylene (conforming to Federal specifications O-1-634A, Type II, and Military Specification MIL-T-7003)

Methylene Chloride (technical grade)

It removes grease, oil solvent residue, lubricating compounds. In addition, its solvent activity permits quick stripping of paint and lacquer films, including latex and the new tough epoxy resin materials.

Equipment cleaned with chlorinated solvents shall be purged with clean, dry air or nitrogen. The purge shall continue until the exhaust can be determined free of solvent vapors when tested with Halogen gas detection equipment.

When ordering, specify inhibited grades of solvent to prevent acidic action on metals where water or water vapors are present. Also, specify that the solvent is for metal cleaning of equipment in oxygen service and that the maximum residue permitted on evaporation is only 0.001% by weight. When drums of solvent are ordered, it is good to specify that all be from the same lot number. This will permit easier and more accurate sampling.

II APCI Experiences and Analysis of Cleaning

A. LOX Tanks

1. Case 1 - Date 1959

Tanks inspected and cleaned after 1-1/2 years of operation. Two tanks were cleaned at this

facility. Tank No. 1 had three pounds of dust containing 2.8% by weight of hydrocarbons which ignited in oxygen at 598°F. Tank No. 2 contained 1-1/2 pounds of dust. Small globules of contaminants outlined a liquid level. These tanks have inlet and outlet nozzles on the same end. Tank capacity is 27,000 gallons.

2. Case 2 - Date 1960

Tanks inspected and cleaned after three years of service. Five gallons of dust were removed, but no definite traces of hydrocarbons were found. No lab analysis is available. Tank capacity is 27,000 gallons with inlet and outlet nozzles on the same end.

3. Case 3 - Date 1960

Tanks inspected and cleaned after two years of service. Three pints of dust were removed. Dust residue was found on all surfaces. Fluorescence under black light in form of rings at liquid levels. (Cases 1, 2, 3 from memo dated 1/24/63 from H. H. Master to J. M. Norwood(5)).

4. Case 4 - Date 1963

Tanks inspected and cleaned after 3-1/2 years of service. The tank was washed down with solvent. Analysis of the solvent used indicated a total of 2.125 grams of hydrocarbons which, averaged out on the complete tank surface, would have been about .7 milligrams of hydrocarbons per square foot. This tank is not of the flow-through type and it is cylindrical. Tank capacity is 28,000 gallons. (Memo dated June 26, 1970 from H. H. Master to W. L. Ball (6)).

5. Case 5 - Date 1964

Tanks cleaned after three years of service. The surface of the tank was clean with no visible traces of oil or other hydrocarbons. However, six pounds of extremely fine silica gel were removed from the tank. The analysis of the silica gel indicated 0.6% by weight to be hydrocarbons. This calculates to 0.04 pounds of

hydrocarbons in the tank. This tank was fed by anyone of six plants at one time or other. The tank capacity is 27,000 gallons and is of the cylindrical type. This tank prior to inspection and cleaning was what is called a dead-ended tank, that is, with the inlet and outlet nozzles being on the same end of the tank. Piping was changed to make it a flow-through tank. (Memo dated 3/11/64 from A. L. Hatley to R. S. Ray (7)).

The tanks listed are all filled from air separation units. All cases other than case 4, are filled from high pressure cycle plants using expansion engine in series with turbo expanders. Case 4 is fed from a split cycle plant. The time tanks were put in service is known, but the throughput of the tank is not known and cannot be estimated because all these locations have more than one tank. A tank in service for one year could have had more throughput than one in service two years.

There are no firm cleaning schedules for liquid tanks. The air separation units are defrosted and blown out on a three year schedule. Should the defrost indicate an unusually high contamination, tank cleaning would be mandatory.

B. Liquid Oxygen Pumps

1. Case 1

Inspected and cleaned after 15,000 hours of operation. Contaminants: 1.29 gr. Pump showed some dust and no visible oil.

2. Case 2

Inspected and cleaned after 2,250 hours of operation. Contaminants: 1.90 gr. Pump showed some dust and no visible oil.

3. Case 3

Inspected and cleaned after an estimated 2,000 hours. Contaminants: 11.1 gr. Pump was black lighted with negative results. No traces of dust reported.

4. Case 4

Inspected and cleaned after 3,100 hours of operation. Contaminants: 3.17 gr. Pump showed some dust and no visible oil.

5. Case 5

Inspected and cleaned after 2,191 hours of operation. Contaminants: 0.34 gr. Pump showed some dust and no visible oil.

In all cases the contaminants were usually assumed to be the same as the lubricant used in the air compressor.

The above mentioned pumps take suction from air separation units. The suction to the pumps has a 100 mesh screen. Cleaning frequencies depend on the type of cycle of the air separation unit as well as past history. Frequencies range from 24 months to 36 months. In newer plants with cleaner cycles (using centrifugal compressors), cleaning is done only if contamination is suspected.

C. Miscellaneous Equipment

Liquid oxygen dump tanks, disposal vaporizers, product vaporizers, and vent stacks are cleaned on a five year maximum interval cycle.

1. Case 1 - 1964

A LOX vaporizer was cleaned after 15 months of service during which a total of 542,486 SCF oxygen was vaporized. The flushing with recirculation method was used. The cleaning solution was methylene chloride. The hydrocarbon contamination analysis showed 0.1056 grams. The contamination accumulating in the vaporizer is negligible as was expected. (Memo from F. K. Kitson to J. J. Mittleman July 1964 (8)).

- (1) APCI Class AAA Cleanliness Requirements
APCI Quality Control Layout No. QCL 107F, July 1, 1971
(Doc. #99000082)
- (2) APCI Requirements for Vendor Class AAA Cleaning
APCI Quality Control Layout No. QCL 117F, July 1,
1971 (Doc. #99000086)
- (3) APCI Class AA Cleanliness Requirements
APCI Quality Control Layout No. QCL 106F, July 1,
1971 (Doc. #99000081)
- (4) APCI Requirements for Vendor Class AA Cleaning
APCI Quality Control Layout No. QCL 116F, July 1,
1971 (Doc. #99000085)
- (5) Master, H. H., Storage Tank Cleaning
APCI Memo, January 24, 1963 (Doc. #99000089)
- (6) Master, H. H., LOX Tanks
APCI Memo, June 26, 1970 (Doc. #99000091)
- (7) Hatley, A. L., Cleaning LOX Storage Tank No. 6 - Santa
Susana
APCI Memo, March 11, 1964 (Doc. #99000090)
- (8) Kitson, F. K., Washout Analysis of Sun Oil Company's
LOX Tank Vaporizer
APCI Memo, July 9, 1964 (Doc. #99000092)
- (9) APCI Cleaning Requirements for Air Plant Equipment
APCI Quality Control Layout No. QCL 101F, July 1,
1971 (Doc. #99000077)
- (10) APCI Cleaning Requirements for Bourdon Tube Type Gages
Used for Oxygen Service
APCI Quality Control Layout No. QCL 102F, July 1,
1971 (Doc. #99000078)
- (11) APCI Approved Cleaning Agents and Associated Equipment
and Supplies
APCI Quality Control Layout No. QCL 103F, December 14,
1965 (Doc. #99000285)
- (12) APCI Class A Cleanliness Requirements
APCI Quality Control Layout No. QCL 105F, July 1,
1971 (Doc. #99000080)
- (13) APCI Requirements for Vendor Class A Cleaning
APCI Quality Control Layout No. QCL 115F, July 1,
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Pennsalt Technical Bulletin, February 3, 1960 (Doc. #99000093)
- (15) Kitson, F. K., Cleaning For Oxygen Service
APCI Memo, August 5, 1963 (Doc. #99000094)
- (16) APCI Cleaning and Inspection, Materials for Oxygen Service
APCI Safety Standards 608.1, October 1965 (Doc. #99000050)
- (17) APCI Cleaning and Inspection for Equipment in Air Plants and in Oxygen Service
APCI Plant Operations Manual, Section 1.08, April 4, 1967 (Doc. #99000095)
- (18) APCI Piping, Valve Procurement and Cleaning Procedure
APCI Design Engineering Standard 579.5, August 12, 1960 (Doc. #99000036)
- (19) Bassler, E. J., Cleaning for Oxygen Service
APCI, January 1960 (Doc. #99000096)
- (20) Master, H. H., Air Separation Plant Contamination, History, Sampling and Analysis
APCI Plant Managers' Safety Meeting, Creighton, Pa., February 28 and March 20, 1968 (Doc. #99000097)
- (21) APCI Exchanger, Plant, and Plant Equipment Solvent Washout Frequencies
APCI Plant Operations Manual Section 5.07, July 15, 1970 (Doc. #99000098)
- (22) APCI Plant Solvent Washout, General
APCI Plant Operations Manual Section 1.05, February 20, 1967 (Doc. #99000099)
- (23) APCI Byron-Jackson Oxygen Pump Washout Procedure for Analytical Purposes
APCI Plant Operations Manual Section 1.07, July 7, 1970 (Doc. #99000286)
- (24) APCI Cleaning
APCI Construction Specification 230.15, page 8, September 16, 1969 (Doc. #99000101)
- (25) APCI Cleaning of Carbon Steel Pipe and Fittings; Cleaning Aluminum Pipe, Fittings, Parts and Fabrications; Cleaning Stainless Steel and Copper Pipe, Fittings, Parts and Fabrications; Description of Cleaning Mediums; Inspection of Decontaminated Components; and Pickling of Carbon Steel Pipe and Fittings
APCI Construction Specifications 200.16.1.7 to 200.17.4, Pages 14-20, February 3, 1967 (Doc. #99000102)

- (26) Coulson, K. J., and I. Everson, Fire Hazards When Vapor Cleaning With Trichlorethylene (T.C.E.)
APL - Safety Department Information Sheet No. 38,
February 10, 1971 (Doc. #99000105)
- (27) Schmoyer, W. W., Carbon Tetrachloride
APCI Safety-Gram No. 68, February 21, 1969 (Doc. #99000106)
- (28) Kehat, E., Detonation Tests of Oil From Aliquippa Pump Suction Filter Defrost and of Methylene Chloride
APCI Memo, December 11, 1961 (Doc. #99000107)
- (29) Smith, H., APCI Solvent and Cleaners--Deviations--Cleaning for Oxygen Service
APCI Safety Standard 629.0.10, June 19, 1961
(Doc. #99000054)
- (30) Himmelberger, F., Notes on Liquid Oxygen Contaminants Missile Program, APCI, January 6, 1958 (Doc. #99000108)

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

B. Compatibility Check

1. Fire Compatibility

The cleaning procedures followed by APL are essentially the same as the ones followed by APCI. These procedures and related ones are covered in the following documents:

- (1) APL, Construction Specifications for Piping Erection Testing and Cleaning, APL Engineering Specification M.02, Rev. 2, April 19, 1971 (Doc. #99000397).
- (2) APL, Solvent Washing of Piping Systems, APL I.G.D. Engineering Manual EM 56-06, Rev. 0, July 3, 1971, (Doc. #99000398).
- (3) APL, General Procedure for Decontamination of Static Tank and Road Vehicle Assemblies for O₂ Service, APL Quality Control Procedure No. Q.10, Rev. 0, (Doc. #99000399).
- (4) APL, Manufacturing Quality Procedure for Degreasing of Pipework, APL Quality Control Procedure No. Q.11, Rev. 0, (Doc. #99000400).
- (5) APL, Manufacturing Quality Procedure for Internal Cleaning of Aluminum Tankers and Static Tanks for Oxygen Service, APL Quality Control Procedure No. Q.12, Rev. 0, (Doc. #99000401).
- (6) APL, Manufacturing Quality Procedure for Internal Cleaning of 9% Nickel and Hi-Proof Stainless Static Tanks for Oxygen Service, APL Quality Control Procedure No. Q.13, Rev. 0, (Doc. #99000402).
- (7) APL, Aloclene 100 and Applied Chemicals 5.57, APL, February 5, 1972, (Doc. #99000403).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

B. Compatibility Checks

1. Fire Compatibility

d. Quality Control

(1) Fire Hazards

(a) procedures

(b) specification

Machining and fabrication controls to reduce ignition and fire hazards involve primarily the cleaning of accessible and inaccessible surfaces prior to or after assembly.

Machined parts constituting rotating or moving pieces are cleaned (after machining) of sulfurized machining lubricants in accord with APCI Class AAA Cleanliness Requirements, Quality Control Layout, QCL107F, Jul 1971 (Doc. #99000082).

This is usually accomplished by immersing in agitated solvent solutions, such as methylene chloride solution. (Refer Pecklam, H. M., and Hauser, R. L., The Martin Company, "Compatibility of Materials with Liquid Oxygen", proceedings of the 1958 Cryogenic Engineering Conference, Advances in Cryogenic Engineering, Vol. 4, Paper A-3, p. 26-46, Plenum Press, Inc. (N.Y.), January 1959 (Doc. #99000189).

Fixed machinery parts are cleaned in a similar manner under slightly less stringent inspection conditions to APCI Class AA Cleanliness Requirements, Quality Control Layout, QCL106F, July 1971 (Doc. #99000081).

Fabrication poses problems on inherent cleanliness in areas such as a) backup strips, b) angle stiffeners, c) cleaning of vessels prior to final closure of the inner vessels, d) brazed aluminum assemblies, e) brazed copper assemblies.

Prior to insertion of weld ring type backup strips in an aluminum or stainless steel piping assembly, the surfaces of both the backing ring and the adjacent pipe are power sanded to a clean bright finish.

Angle stiffeners whose flat edges bear against the plate are fully fillet welded on both sides so that the flat surfaces are completely encased and never see the product fluid or gas.

Prior to final closure of vessels without manway openings the internals of the vessels are washed with an acceptable solvent and examined to either:

- a) APCI Class B Cleanliness Requirements, Quality Control Layout, QCL104F, July 1971 (Doc. #99000079),
- or b) APCI Class A Cleanliness Requirements, Quality Control Layout, QCL105F, July 1971 (Doc. #99000080),

dependent on the final product, and as indicated in:

APCI Cleaning Requirements for Air Plant Equipment, Quality Control Layout, QCL101F, July 1971 (Doc. #99000077).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

B. Compatibility Checks

1. Fire Compatibility

d. Quality Control - APCI

(2) Programs

(a) policies

(b) practices

APCI Quality Manual determines cleanliness requirements for all phases of manufacture and for all purchased material and equipment. These requirements are self-explanatory and are covered by the following documents:

- (1) APCI Cleaning Requirements for Air Plant Equipment, Quality Control Layout, QCL101F, July 1971 (Doc. #99000077).
- (2) APCI Cleaning Requirements for Bourdon Tube Type Gages Used for Oxygen Service, Quality Control Layout, QCL102F, July 1971 (Doc. #99000078).
- (3) APCI Class B cleanliness Requirements, Quality Control Layout, QCL104F, July 1971 (Doc. #99000079).
- (4) APCI Class A Cleanliness Requirements, Quality Control Layout, QCL105F, July 1971 (Doc. #99000080).
- (5) APCI Class AA Cleanliness Requirements, Quality Control Layout, QCL106F, July 1971 (Doc. #99000081).
- (6) APCI Class AAA Cleanliness Requirements, Quality Control Layout, QCL107F, July 1971 (Doc. #99000082).
- (7) APCI Requirements for Vendor Class B Cleaning, Quality Control Layout, QCL114F, July 1971 (Doc. #99000083).
- (8) APCI Requirements for Vendor Class A Cleaning, Quality Control Layout, QCL115F, July 1971 (Doc. #99000084).
- (9) APCI Requirements for Vendor Class AA Cleaning, Quality Control Layout, QCL116F, July 1971 (Doc. #99000085).

- (10) APCI Requirements for Vendor Class AAA Cleaning, Quality Control Layout, QCL117F, July 1971 (Doc. #99000086).
- (11) APCI Brazed Aluminum Heat Exchanger Cleaning Requirements, Quality Control Layout, QCL119F, July 1971 (Doc. #99000087).

It should be noted that the brazed aluminum heat exchanger cleaning is performed to remove flux, in particular, and contaminants, in general, in order to protect against corrosion, as well as against ignition and fire hazard.

The following references are of interest in relation to cleaning requirements for oxygen service:

- (1) APCI Requirements for Vendor Class B Cleaning, Quality Control Layout, QCL114F, July 1971 (Doc. #99000083).
- (2) APCI Requirements for Vendor Class A Cleaning, Quality Control Layout, QCL115F, July 1971 (Doc. #99000084).
- (3) APCI Requirements for Vendor Class AA Cleaning, Quality Control Layout, QCL116F, July 1971 (Doc. #99000085).
- (4) APCI Requirements for Vendor Class AAA Cleaning, Quality Control Layout, QCL117F, July 1971 (Doc. #99000086).
- (5) APCI Requirements for IPD Specified Paint Systems, Quality Control Layout, QCL120F, July 1971 (Doc. #99000088).
- (6) Compressed Gas Association, "Equipment Cleaned for Oxygen Service," CGA Pamphlet G-4.1, March 1959 (Doc. #99000198).
- (7) Kehat, E., "Hazard Level of Hydrocarbon Films in Systems Containing Liquid and Gaseous Oxygen," *Advances in Cryogenic Engineering*, Vol. 1, pp. 163-169, 1962 (Doc. #99000199).
- (8) Ball, W. L., "Hazard Level of Hydrocarbon Films in Oxygen Systems," *AIChE-CEP Tech. Manual, Safety in Air and Ammonia Plants*, Vol. 4, pp. 16-20, 1962 (Doc. #99000200).
- (9) Walde, R. A., "Relationship of the Chemical Structure of Cutting Oils to Their Oxygen-Compatibility," *AIChE-CEP Tech. Manual, Safety in Air and Ammonia Plants*, Vol. 7, pp. 21-23, 1965 (Doc. #99000201).
- (10) Lapin, A., Discussion with Mr. E. Lucas-IPD Inspection, Regarding APCI Cleanliness Requirements, APCI Memo, July 22, 1971 (Doc. #99000221).

- (11) Lapin, A., Telephone Conversation with Mr. William McCormick regarding Requirements for Vendor Class AA and Class AAA Cleaning, APCI Memo, July 22, 1971 (Doc. #99000222).
- (12) Kehat, E., "Hazard Level of Hydrocarbon Films in Systems Containing Liquid and Gaseous Oxygen," Cryogenic Engineering Conference, Ann Arbor, Michigan, USAF Contract AF33(616)6730, August 15-17, 1961 (Doc. #99000303).
- (13) Frederick, L. G., D. R. Latshaw, APCI Analytical Report on Fluorescence of Various Types of Oils -- Mobil DTE-105, Texaco Cappella - A, Cellulube 550, Fluorolube, Sears Thread Cutting Oil, July 15, 1971 (Doc. #99000311).
- (14) ASTM Standard Pictorial Surface Preparation, ASTM Standards for Painting Steel, ASTM-D2200-67, 1967 (Doc. #99000339).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Materials Compatibility

B. Compatibility Check

1. Fire Compatibility

d. Quality Control - APL

(2) Programs

(a) Policies

(b) Practices

The following references represent APL practices relative to cleanliness and quality control requirements for equipment used in oxygen service:

- (1) APL, Acceptance Test for Class B Cleanliness, APL Engineering Specification A.01, Rev. 0, May 12, 1969, (Doc. #99000360).
- (2) APL, Acceptance Test for Class A Cleanliness (High Purity Clean), APL Engineering Specification A.02, Rev. 0, May 12, 1969, (Doc. #99000361).
- (3) APL, Acceptance Test for Class AA Cleanliness (Oxygen Clean), APL Engineering Specification A.03, Rev. 0, April 1, 1971, (Doc. #99000362).
- (4) APL, Degreasing Acceptance Tests for Oxygen Service Compressors, APL Engineering Specification K.02, Rev. 0, June 23, 1969, (Doc. #99000363).
- (5) APL, Valves - Oxygen Service: Minimum Decontamination and Test Requirements, APL Engineering Specification L.06, Rev. 0, July 7, 1969, (Doc. #99000364).
- (6) APL, Construction Specification for Piping Erection, Testing and Cleaning, APL Engineering Specification M.02, Rev. 2, April 19, 1971, (Doc. #99000365).
- (7) APL, Specification for Oxygen Service Vessel Fabrication (Designed by APL Fabrication by Vendor), APL Engineering Specification C.03, Rev. 2, July 26, 1971, (Doc. #99000366).



- (8) APL, Specification for Oxygen Service Pressure Vessel Fabrication (Designed and fabricated by the Vendor), APL Engineering Specification C.04, Rev. 2, July 26, 1971, (Doc. #99000367).
- (9) APL, Brazed Core Extended Surface Heat Exchangers, APL Engineering Specification E.02, Rev. 4, June 28, 1970, (Doc. #99000368).
- (10) APL, Shell & Tube Type Cooler, Other Than for O₂ Service (APL Plants), APL Engineering Specification E.04, Rev. 1, June 1, 1971, (Doc. #99000369).
- (11) APL, Shell & Tube Type Coolers for O₂ Service, APL Engineering Specification E.05, Rev. 1, June 1, 1971, (Doc. #99000370).
- (12) APL, Centrifugal Cryogenic Pumps, APL Engineering Specification, G.03, Rev. 0, April 1, 1971, (Doc. #99000371).
- (13) APL, Pressure Gauge - Oxygen Service, APL Engineering Specification J.07, Rev. 0, June 18, 1969, (Doc. #99000372).
- (14) APL, Pressure Regulating Valves for Oxygen Service, APL Engineering Specification J.15, Rev. 0, June 18, 1969, (Doc. #99000373).
- (15) APL, Relief Valves, Warm Gas Service, -20°F +100°F, APL Engineering Specification J.18, Rev. 0, June 18, 1969, (Doc. #99000374).
- (16) APL, Transfer Hose for Cryogenic Liquids, APL Engineering Specification L.11, Rev. 0, July 7, 1969, (Doc. #99000375).
- (17) APL, Flexible Hoses for Charging and Discharging Manifolds Oxygen Service, APL Engineering Specification L.12.1, Rev. 0, July 7, 1969, (Doc. #99000376).
- (18) APL, Unsintered P.T.F.E. Tape, APL Engineering Specification L.14, Rev. 0, July 8, 1969, (Doc. #99000377).
- (19) APL, Cryogenic Liquid Hose Couplings for Use in the U.K., APL Engineering Standard LS.08, Rev. 0, October 21, 1969, (Doc. #99000378).
- (20) APL, Expanded Perlite, APL Engineering Specification N.01, Rev. 0, January 1, 1970, (Doc. #99000379).
- (21) APL, Mineral Wool, APL Engineering Specification N.02, Rev. 0, January 2, 1970, (Doc. #99000380).
- (22) APL, Insulation - Preformed Cellular Glass Section for Pipelines, APL Engineering Specification N.05, Rev. 0, October 1, 1970, (Doc. #99000381).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

B. Compatibility Checks

2. Structural Materials Compatibility

APCI experience with oxygen service has been with both metallic materials, and non metallics for gaskets and packing.

- a. (1) Chemical reactions and alloy modifications due to oxygen diffusion are not known to affect material strength, and therefore are not a factor considered in the selection of metallic materials for oxygen service.
 - (2) Material composition is not a factor, but both mechanical and thermal properties are. The change in mechanical and thermal properties with temperature are considered.
 - (3) Metallurgical changes such as embrittlement at lower temperatures is a factor with all construction materials. However, this is due to the low temperatures produced by cryogenics, with no special consideration for oxygen.
 - (4) Coatings and claddings are not factors considered for oxygen service because there is no need for them.
 - (5) Exposure to secondary reagents is not a factor for oxygen service because of a low probability of being exposed to them.
- b. Structures and support systems are designed to safely accommodate the dimensional changes produced by temperature differences between ambient to low temperature operation. This is generally accomplished by providing flexibility between structures to minimize interaction forces.
 - c. Notch-sensitivity is a factor in material selection, and is indicated by tests on a notched tensile specimen or by means of a notched-impact specimen. The latter is in general use and is required by the ASME Pressure Vessel Codes (1,2). The notch in the impact specimen represents the stress raiser which may be present in the as-built structure, or developed during subsequent operation. Operating experience indicates that

code rules governing design, material examination, and weld acceptance standards have been sufficient to minimize failures due notch sensitivity.

- d. Fabrication and welding is carried out in accordance with the ASME Pressure Vessel code (1,2) rules with satisfactory results. Inspection meets the National Board requirements (3).
- e. Materials and parts suitability controls are carried out in accordance with the ASME Pressure Vessel Code rules with satisfactory results.
- f. Composite materials have not been used for pressure carrying parts for oxygen service.
- g. As indicated earlier, APCI has had experience with non-metallic valve inserts and butterfly and ball valve seats and seals. Kel-F Teflon, and glass-filled Teflon have been satisfactory, particularly for tight shut-off conditions. APCI's Design Engineering Standard 578.60.1 (4) on oxygen piping should give APCI's current practices. This should be an excellent document for describing somewhat completely materials and conceptual requirements. Also the CGA's Oxygen Pipeline Subcommittee rough draft of March 30, 1971, "Assembly of Industrial Practices Used For Gaseous Oxygen Transmission and Distribution" (5), should be a fine reference document.
- h. References

- (1) American Society of Mechanical Engineers, Pressure Vessel Division, ASME Boiler and Pressure Vessel Code Section VIII, 1971 (Doc. #99000210).
- (2) American Society of Mechanical Engineers, Welding Qualifications, ASME Boiler and Pressure Vessel Code 1971 (Doc. #99000211).
- (3) National Board Inspection Code, A manual for boiler and pressure vessel inspectors, The National Board of Boiler and Pressure Vessel Inspectors, Columbus, Ohio, 1968 (Doc. #99000212).
- (4) APCI, Oxygen Piping, APCI Design Engineering Standard 578.60.1, April 24, 1972 (Doc. #99000028).
- (5) Compressed Gas Association, Assembly of Industrial Practices Used for Gaseous Oxygen Transmission and Distribution, CGA Docket 70-11, March 22, 1972 (Doc. #99000345).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

B. Compatibility Check

2. Structural Materials Compatibility

a. Relationship of Material Strength to Maximum Stress Over the Working Temperature Range as Affected by:

(1) Chemical reactions and alloy modifications due to oxygen diffusion,

and (2) Materials composition and property changes

No consideration is given to the effect of chemical reactions and possible alloy modifications due to oxygen diffusion. Testing of copper tubing and lead-tin solders after ten years of intermittent cryogenic service have given no indication of deterioration of material properties. Stainless steels and aluminum alloy which form inner cryogenic vessels of insulated systems have shown no appreciable deterioration of vacuum after eight-ten years of service and it is felt that appreciable diffusion would be evident in this period of time. It is not considered, on this basis, that significant changes in properties take place in the above alloys. Thermal cycling of highly strain hardened stainless steel under experimental conditions has been found to produce transformation of up to 15% of the normally austenitic structure to martensite.

However, no service failures have occurred which can be attributed to these factors.

(3) Metallurgical changes such as embrittlement

No known failures have occurred by any suspected embrittlement phenomenon thought to be associated with oxygen diffusion.

(4) Effects of coatings and claddings

While some fear existed in the early 9% nickel steel vessels that dissimilar weld metal and reinforcement pad material would provide dangerously different expansion coefficients, results of several years' service tend to indicate otherwise. The inconel type filler metals in use as weld metal for the 9% nickel steels have taken part in no field type failures. Similarly, clad material would appear to offer no great disadvantage, providing the properties of both the cladding and the material being clad were compatible with the temperature of operation.

Experimental and service history has been obtained with the Aluminum-Stainless Steel roll bonded transition piece, and the Aluminum-Copper-Stainless Steel brazed transition piece, and the Aluminum-Copper-Stainless Steel brazed transition pieces. Under modest loads, no degradation of bond takes place, even after several hundred cycles from ambient to cryogenic conditions. Similarly, the silver welded alum-stainless steel transition has shown exceptionally good resistance to stresses imposed by cycling.

- (5) Compatibility losses through exposure to secondary reagents which are natural to systems or introduced by accidents.

Failures of materials in rich or lean gaseous oxygen service is typified by "wet atmospheres" with traces of chlorides. Upon condensation in the system, an accumulation of chlorides can occur which may seriously affect stainless steels, and the brasses commonly used for condenser tubing, and could cause failure usually by a stress corrosion mechanism. The same conditions on aluminum alloys results in a rather general corrosion pattern.

Improper materials selection or improper protection of materials on the water side of heat exchangers produces galvanic couples which results in premature failures of shells, baffles, etc.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

B. Compatibility Checks

2. Structural Materials Compatibility

c. Notch sensitivity of materials over temperature range of use as affected by:

(1) Thermal Fatigue

No specific information.

(2) Allowable defect size (fabrication or material fault)

and (3) Allowable crack growth and rate of crack growth

Allowable defect sizes, where measured, have been in accord with ASME Code, Sec. VIII, Para. UW-51, (Doc. #99000210) and its associated porosity standard. No failures have occurred which are attributable to residual defects of this size. Investigations regarding allowable crack growth and rate of crack growth have been non-existent except for some preliminary studies referred to below which show growth of cracks in an aluminum alloy at ambient temperatures under cyclic loads:

Erdogan, F. and R. Roberts, "A Comparative Study of Crack Propagation in Plates Under Extension and Bending" Proceedings of the First International Conference on Fracture, Vol. 1, p. 341-362, 1965 (Doc. #99000213).

Roberts, R. and F. Erdogan, "The Effect of Mean Stress on Fatigue Crack Propagation in Plates Under Extension and Bending," Presented at the ASME Winter Annual Meeting, Pittsburgh, Pa., November 12-17, 1966 No. 67-WA/Met-2 (Doc. #99000214).

Loushin, L. L., W. J. Lambertin, and A. J. Polmer, "An Application of Fracture Mechanics to Safe Life Design in Cryogenic Pressure Vessels", Esso Research and Engineering Company, Report No. EE.26ER.70, August 24, 1970, (Doc. #99000215).

Tafuri, J. C. and R. Roberts, "Fatigue - Crack Growth Rates and Fracture Toughness Study of Welded Aluminum Alloy 5083", Presented at the ASME Winter Annual Meeting, November 29 - December 3, 1970, Paper No. 70-WA/PVP-5 (Doc. #99000216).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

B. Compatibility Checks

2. Structural Materials Compatibility

d. Fabrication and Welding (Include guide to material and weld defect repairs).

Material and welding defect repairs are required when defects are more serious than those allowable in ASME Code, Section VIII, Para. UW-51 or UW-52 (Doc. #99000210), (whichever is applicable).

In all cases, the defect is removed by grinding (using aluminum oxide or silicon carbide wheels, high speed burrs, or a file) and the area in question is examined by either a dye penetrant or radiographic technique to insure removal of the defect prior to rewelding. Even with visual and dye penetrant techniques, however, defect recognition and removal sometimes escapes the operator and repetitive repair welding of the same area is required. In these instances the aluminum alloys tend to over-age, or segregate, and hot cracking of the adjacent parent material can take place. A cure for this condition is sometimes a local annealing or solution treating operation. By the same token, 9% nickel steel impact properties can be seriously affected by repetitive welding operations in a localized area. Stainless Steels are remarkably free of any of the above troubles.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

I. Material Compatibility

B. Compatibility Checks

2. Structural Materials Compatibility

e. Materials and parts suitability controls

(2) Vendor procedures on purchased equipment

Vendor procedures for fabrication are similar to APCI in that the code and cleaning requirements, where imposed, regulate fabrication.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

A. Overpressure

1. Safety relief valves are installed in accordance to APCI Piping Group Memo #19 (1).
2. Thermal relief valves are always installed in any section of cold piping which lies between two valves.
3. Low point drains are generally provided to minimize trapped liquids.
4. Refer to Review Forms IIA⁴-1 and IIA⁴-2.
5. Structural loads on venting systems are determined as per APCI Piping Group Memo #19 (1).
6. Piping is designed to ANSI B31.3 "Petroleum Refinery Piping" (2) or ANSI B31.5 "Refrigeration Piping" (3) to guard against failure from overpressure. For a treatise on failures due to defects see: THIELSCH, HELMUT "Defects and Failures in Pressure Vessels and Piping" (4) Reinhold.
7. Velocities in gaseous oxygen systems are limited to a maximum of 200 feet per second. Surges on pressure waves should be avoided and the piping system designed for what is considered an economical pressure drop.

Flow of liquid should be controlled so there is not a great rate of change in velocities in the system to minimize pressure surges (commonly known as water hammer). Refer to bibliography on Water Hammer (5), for additional information.

B. Cited References

1. APCI, Safety Relief Valves, Location and Piping Design Considerations, APCI Piping Group Memo #19, November 3, 1966 (Doc. #99000346).
2. ANSI B31.3, Petroleum Refinery Piping, American National Standard Institute (Ex American Standard Association), 1966 (Doc. #99000347).

3. ANSI B31.5, Refrigeration Piping, American National Standard Institute (Ex USA Standard), 1966 (Doc. #99000348).
4. Thielsch, Helmut, Defects and Failures in Pressure Vessels and Piping, Reinhold Publishing Corporation, New York, 1965 (Doc. #99000349).
5. APCI, An Analysis of Water Hammer in Cryogenic Transfer Lines, The Mississippi Test Facility of the George C. Marshall Space Flight Center, National Aeronautics and Space Administration; APCI, February 28, 1964 (Doc. #99000358) (Bibliography p. 86 only).

C. Additional References

1. APCI, Pressure Vessels -- Gaseous Oxygen Storage Cylinder, APCI Design Engineering Standard 515.1.3, October 17, 1960 (Doc. #99000016).
2. APCI, Pressure Vessels -- Vessel Design Basis and General Standards, APCI Design Engineering Standard 510.1, August 1962 (Doc. #99000018).
3. APCI, Pressure Vessels -- Materials of Construction, APCI Design Engineering Standard 510.1.4, June 1962 (Doc. #99000019).
4. APCI, Pressure Vessels -- Shell Design, APCI Design Engineering Standard 510.2, February 1965 (Doc. #99000020).
5. APCI, Pressure Vessels -- Head Design, APCI Design Engineering Standard 510.3, August 1962 (Doc. #99000021).
6. APCI, Instrumentation -- Special Requirements for Safety and Relief Valves, APCI Design Engineering Standard 537.9, July 1965 (Doc. #99000024).
7. APCI, Piping -- Extended Bonnet Valve Code, APCI Design Engineering Standard 579.4, April 1963 (Doc. #99000035).
8. APCI, Plant Components, Cold Boxes, APCI Safety Standards 607.1.5, January 1963 (Doc. #99000045).
9. Kitson, F. K., Rupture Discs Manufactured LOX Tankers by Ametek, APCI Memo, June 22, 1971 (Doc. #99000314).
10. Compressed Gas Association, Safety Relief Device Standards PT-3, Compressed Gas Storage Containers, CGA Pamphlet S-1.3, 1966 (Doc. #99000315).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

A. Overpressure

4. Integrity of Insulation

I. Shop Fabricated LOX Storage Tanks

These tanks are of double wall construction with the annular space filled with Perlite insulation and evacuated to 10 microns pressure. The integrity of the insulation is not affected by the internal pressure of the inner tank except in the case of failure or leakage of the inner tank. To prevent overpressuring of the inner tank, pressure relieving devices are installed using the following design criteria.

- A. Safety Valves are set at 100% design pressure and sized to relieve the largest of the flows listed below.
 - 1. LOX vaporized due to normal heat leak boil-off.
 - 2. Gas volume equal to maximum filling rate (vent valve assumed closed).
 - 3. Maximum gas flow for pressurization valve failure in wide open position.
- B. Rupture disc set at 120% of design pressure and sized to relieve the largest of the flows listed below minus the safety valve capacity.
 - 1. Vessel exposed to fire with Perlite in the annular space but no vacuum. The amount of LOX vaporized is calculated using the equation in paragraph 4.3.5 in CGA Pamphlet S-1.3 Safety Relief Device Standards, Part 3, Compressed Gas Storage Containers (Doc. #99000315).
 - 2. LOX vaporized due to heat leak assuming vacuum is lost in the annular space. Heat leak will increase up to 350 times that of a tank with the design vacuum in the annular space.

The outer tank is protected by a spring loaded lift plate to relieve overpressures above 2-3 psi in the annular space.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

A. Overpressure

4. Integrity of Insulation

II. Field Fabricated, flat bottom LOX Storage Tanks

These tanks are of double wall construction with the annular space filled with Perlite and purged with nitrogen. The integrity of the insulation system on these tanks are affected in the same way as for the shop fabricated tanks (IIA4-1). The pressure relieving devices for the inner tank are sized using the following design criteria.

A. Pressure - Vacuum relief valves are used to protect the inner tank.

1. The pressure setting is 5 psig and the valve is sized to relieve the largest of the operating conditions listed below.

a. LOX vaporized due to normal heat leak boil-off plus LOX flashing in tank under filling conditions.

b. Relief of gas volume equal to maximum filling rate (vent valve assumed closed)

2. The vacuum setting is 1/2 oz. and the valve is sized for a gas volume equal to maximum pump-out rate.

B. Pressure - Vacuum relief valves are used to protect the outer tank.

1. Pressure setting is 2" H₂O and valve is sized to relieve the maximum nitrogen purge flow with purge control valve failing wide open or the expansion of the purge gas due to an exterior fire.

2. Vacuum setting is 1" H₂O and valve is sized to handle the variations the annular space gas volume due to ambient thermal cycling.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

B. Disposal of Vented Gases

1. Company Practices

a. Air Plants

Although NASA is not interested in air separation plants in this particular study, our policy of segregating various defrost, disposal and reactivation lines to vent stacks may be applicable to some of their operations. Basically, this is merely an isolation of pure oxygen or oxygen rich vent manifolds and stack from other vents which have or may possibly contain incompatible materials. Refer to APCI Safety Standard 607.1.12, Pages 7 and 8⁽¹⁾.

b. Safety Valves

Safety valve discharges are piped outdoors where such equipment may be in buildings or confined areas. Safety considerations for the vent area are to include adequate ventilation to prevent oxygen concentrations or hazards to personnel. Personnel hazards would include flammability possibilities, cryogenic burns and harmful effects of high velocity gases directed on individuals.

Safety valve discharges can be manifolded and extended to a safe area providing the piping manifold is sized to prevent excessive back pressure on the valves which would effect the relief setting. Cases have been considered on individual basis whereby individual safety valve discharge vents or manifolded systems are tied into the proper defrost, disposal or reactivation stacks (mentioned above) to extend discharges to a safe or safer distance without duplicating long piping runs. All manifold valves must be piped properly, including unions on the discharge piping, so they can be removed for repair, replacement or checks.

Safety discharges must be protected from weather and other possible adverse effects. If discharges are not manifolded, they must have an elbow facing downward (but not in areas frequented by personnel) in the discharge part or have a pipe nipple with the bottom outboard end cut off at a 45° angle.

Further details are in Safety Standard 607.1.12⁽¹⁾ and Design Engineering Standard 578.60.1⁽²⁾.

c. Product Loading Areas

Operations Department has installed systems in loading areas where gas vented from highway tankers being filled can be a hazard to operators, equipment and in some cases to third parties where the activities are located reasonably close to public thoroughfares, to handle these vented gases. Climatic conditions (little or no wind velocity, high humidity, etc.) can increase the hazards as vapors tend to remain in the area and close to the ground.

These systems consist of a flexible hose attachment on the tanker vent which connects to a manifold piped to a 500-gallon aluminum tank. A vent stack off the top of the tank extends from 20 feet to 30 feet above grade depending on the location and magnitude of the problem. The primary purpose of the 500-gallon tank (92483D)(3) is to act as a "buffer" in the event a tanker is inadvertently permitted to overflow. Secondary purpose is to use it as a dump tank for off-specification liquid or discarding residual liquid in a tanker that is to be converted to another product.

Some refinements to the system, depending again on the location, overall problem and the fact that the loader may not always be in the immediate area, are:

1. An air blower (generally 1700 CFM) is set on the tank and discharges, at an angle, into the stack so as to act as an eductor. This air serves to dilute the gas concentration and also to heat the vapors to prevent their "dropping" to the ground level. Actuation of the blowers varies according to needs. Where frequent service is required it is kept operating, for all practical purposes, constantly. Others turn it on as necessary. A number of locations have a temperature-actuated switch with a sensing bulb in the stack. The temperature switch is set to the lowest temperature practical below that of expected low for the geographical location.

2. Level switches (usually set at about 5 inches) are piped into the side of the tank, near the bottom, where loaders may leave the immediate area. This switch is set to actuate an alarm to warn the loader that the tanker is over-filled and passing liquid into this tank. The loader would be expected to get back to the loading pad and immediately shut the fill valve. Where the loader may be an appreciable distance away, the switch would also stop the blower to prevent a possible reaction should the liquid reach the blower discharge before the fill valve is shut. Where the tank is used for disposal of liquid, a by-pass switch may be necessary to take this switch out of the blower and alarm circuits during this operation. A red warning shall indicate it is on by-pass and in this case, the loader should not be permitted to leave the area.
3. Most facilities have more than one product loaded at the same site. Separate manifolds are used for each product, but they do tie into a common tank. The separate manifolds are to preclude the possibility of reverse flow of one product into another and is particularly important where oxygen may back into a high-purity nitrogen tanker where 25 ppm or less oxygen is standard. The blower-education system supplements this control in that its operation tends to clear out all vapors and, depending on the number of simultaneous loadings, may effect a slight negative pressure within the tank. Another back up system for cross contamination is a swing check valve where each tanker ties into the manifold system with the flexible hose. These check valves are on all systems.
4. Storage tank vents, relief valve discharge piping, and pump cooldown lines have been tied into these dispersal system tanks where necessary and convenient.

All new facilities are required to have some dispersal system for trailer vents in load areas. Where multiple usage is practical, the above system need not be incorporated. The Wharton plant has a large capacity dump tank for discharging off-specification liquid during startup periods. This doubles as a trailer load system vent. At Lone Star a product vaporizer (cooling water as a vaporizing medium) has a separate coil for dumping liquid from the hydrocarbon and guard adsorbers when they are to be reactivated. The tanker vapor lines are teed into the circuit, pass through the vaporizer, and go to an existing stack.

We are presently in a program for automating loading systems whereby the shutoff valves are actuated by a liquid level switch on the trailer. For these systems, the dispersal tank with the blower and the level switch are a compulsory part of the automation. In addition to providing safe venting conditions, the system provides a backup for the automation. If the fill valve fails to close on the tanker contained circuitry, the overflow operates the dispersal tank switch which in turn interrupts the power to the fail-close automatic valves and also sounds an alarm and shuts off the blower. The "Auto-Load" systems are described in some detail in H. H. Master's memoranda dated March 22, 1971(4) and April 5, 1971(5).

In addition to direct safety aspects, the trailer venting system has a direct economic advantage in that it reduces the curb stop and pad deterioration caused by cold gases and liquids. Also, accidental spills have resulted in the necessity for tire replacement numerous times and amounts saved in this respect are not calculable but are known to have been high.

d. Disposal Problems

Problems related to the disposal of cryogenic vapors are covered in APCI Safety - Gram No. 17 (6), H. H. Master's paper subject "Product Vapor Hazards"(7), J. B. Gayle's paper subject "Fire Incident in an Oxygen Cloud"(8), and A. Lapin's paper subject "Oxygen Diffusion in the Atmosphere for Liquid Oxygen Pools" (9, 10).

References

- (1) APCI, Air Separation Plant, Piping, Valves and Safety Relief Devices, APCI Safety Standard 607.1.12, October 1962 (Doc. #99000046).
- (2) APCI, Oxygen Piping, APCI Design Engineering Standards 578.60.1, April 27, 1971 (Doc. #99000028).
- (3) APCI, LOX and LIN Vapor Disposal Tanks (500 Gal.), APCI Drawing 92483D, Rev. B, September 30, 1968, (Doc. #99000247).
- (4) Master, H. H., "Lathrop Auto-Load System," APCI Memorandum to W. J. Scharle, March 22, 1971, (Doc. #99000248).
- (5) Master, H. H., "Auto Load Systems," APCI Memorandum to W. J. Scharle, April 5, 1971, (Doc. #93000249).
- (6) APCI, A Misty Problem, APCI Safety Gram No. 17, August 10, 1962, (Doc. #99000250.)
- (7) Master, H. H., "Product Vapor Hazards," APCI (Doc. #99000251).
- (8) Gayle, J. B., "Fire Incident in an Oxygen Cloud," Fire Journal, pages 76-78, 81, Jan. 1971 (Doc. #99000252).
- (9) Lapin, A. and R. H. Foster, "Oxygen Diffusion in the Atmosphere from Liquid Oxygen Pools," Advances in Cryogenic Engineering, Vol. 13, pp. 555-565, 1968 (Doc. #99000599).
- (10) Lapin, A. and R. H. Foster, "Oxygen Diffusion in the Atmosphere from Liquid Oxygen Pools," Compressed Gas Association, Air Separation Plant Safety Symposium, pp. 12-23, Chicago, Illinois, April 23, 1969 (Doc. #99000600).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

B. Disposal of Vented Gases

1. Cleanliness of disposal system (compatibility with oxidizer).

Report IIB1-2 covers our approach to this question including conformance to Safety Standard 608.1⁽¹⁾. This standard limits particulate size and quantity to an acceptable value to prevent plugging of operating equipment and to eliminate particle friction as a source of ignition. Additionally, these values are acceptable for most commercial applications involving control valves, orifices, etc.

Materials utilized in disposal and vent systems are limited to corrosion resistant types such as copper, brass, austenitic stainless steel and monel. Objective here is to maintain the cleanliness level originally achieved while utilizing materials suitable for cryogenic temperatures. Design Engineering Standard 578.60.1⁽²⁾ reflects this philosophy.

2. Proximity of other activities to vents which may be endangered by oxidizers, dilution methods for safe concentrations.

Our basic philosophy is to vent far enough away from personnel areas or operating equipment to permit natural dilution to safe limits. Distances are indicated by following standards:

| | |
|----------------------------------|-------------------------------|
| 578.60.1 ⁽²⁾ | Vents from oxygen compressors |
| 607.1.12 (page 9) ⁽³⁾ | Vaporizer vents |

Vaporizers are designed to vent cold gas. Vent piping must be directed away from carbon steel components to prevent cooling below -20°F.

Relative locations of vents, drains and defrost stacks are covered by Safety Standards 605.1.3⁽⁴⁾, Air Separation Plant Layout.

3. References.

(1) APCI Cleaning and Inspection, Materials, Oxygen Service, APCI Safety Standards 608.1, October 1965 (Doc. #99000050).

(2) APCI Oxygen Piping, APCI Design Engineering Standards 578.60.1, April 24, 1972 (Doc. #99000028).



- (3) Kitson, F., APCI, Plant Components, Air Separation Plant, Piping, Valves and Safety Relief Devices, APCI Safety Standards 607.1.12, October, 1962 (Doc. #99000046).
- (4) Ball, W. L., Criteria Air Separation Plant Layout, APCI Safety Standards 603.1.3, January 6, 1961 (Doc. #99000043).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

B. Disposal of Vented Gases

1. Cleanliness

The approach to cleanliness of oxygen piping is covered in detail in APCI Construction Specifications. A typical example would be the APCI Construction Specifications, General Construction and Equipment Erection, Oxygen Compression System, El Segundo, Calif. Section 200.0 to 200.20, Revised November 17, 1969 (Doc. #99000338). Additional requirements are found in APCI, Cleaning and Inspection of Materials in Oxygen Service, APCI Safety Standards 608.1, October 1965 (Doc. #99000050).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

B. Disposal of Vented Gases

4. Procedural arrangements

APCI criteria for the design of oxygen piping are covered by APCI Design Engineering Standards 578.60.1 for oxygen piping dated April 27, 1971 (Doc. #99000028).

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LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

C. Coupling to Other Systems

1. Isolation arrangements for keeping oxidizers out of adjacent systems; considerations of operational errors or leaks through valves.

Leakage of oxygen to nitrogen is normally prevented by use of double check valves (Circle Seal series 232B with Viton O-ring seals) located between manual double block valves (ball type with Teflon seals). The chamber between the block valves is vented to the atmosphere through a vent valve and check valve. The check valve is utilized to prevent entrance of contaminants during extended periods when the vent valve is open.

Where nitrogen gas is utilized for purging hydrocarbon systems and the gas originates in a vessel common to the oxygen (distillation column), a special isolation system is utilized to prevent backflow of hydrocarbons into the oxygen column in case nitrogen pressure diminishes below normal levels. Automatic double block valves are utilized with an automatic vent valve between them. Actuation is by loss in pressure or loss of nitrogen purity.

Accidental contamination of oxygen piping and instruments with oil is normally prevented by segregated piping and instrumentation so that oil leakage cannot occur around oxygen containing components.

2. Temperature coupling to adjacent systems; cooling, cold condensate, leakage of cool liquids on adjacent systems.

Basically, we normally employ stainless, aluminum and copper for the portion of systems operating below -20°F and for warmer piping up to an alarm switch set to warn operator of falling temperatures below -5°F . Thereafter, carbon steel is usually utilized unless maintaining cleanliness during construction or during operation is a problem.

Compressors, which are vulnerable to liquid carryover from a liquid source, are protected by a liquid trap in addition to a temperature alarm and shutdown systems.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

D. Spills and Leakage

The general rule is to repair oxygen gas or liquid leaks immediately. If leaks are minor and in a relatively safe area, and it is not practical to fix them immediately they would be fixed at the first opportune moment. For bad leaks in hazardous areas, of course, the leak is to be fixed immediately. Minor leaks where there is a real potential hazard, such as a cracked fitting which could break completely, would be repaired immediately.

No leaks are to be repaired until all pressure in the appropriate circuits has been bled down. When torches or welding are necessary for repairs, circuits must be purged with nitrogen and tested for 21% oxygen or less atmospheres. Also, hot work requires positive blank of source of oxygen. Positive blanks include complete disconnect of line by mechanical means, blank inserted between flanges, or two block valves with a bleed to atmosphere between them. Naturally, all tools and fittings should be cleaned appropriately before use and the area should be cleaned and dried after work has been completed.

Our main area of concern regarding spills is in the load-unload areas. There have been a number of major spills, generally due to truck pulling out before disconnecting the transfer hose. All of the newer facilities have remote operated shutoff valve on storage tank lines in the event there is line breakage. Older plants are under investigation and no decisions have been made in this matter. Presently there are 31 LOX tanks in this load-unload category, 11 of which have remote shut off valves. There have been a number of incidents where drivers have pulled away and torn up our loading area lines. However, all were caught and handled immediately so no major incidents resulted. Generally, the manual valve was closed and damage repaired as necessary. One such recent happening was at a location where they had a remote valve but this was on a LIN system.

The majority of our loading areas have water deluge systems installed, manually actuated, which would serve to vaporize spilled liquid and at least prevent propagation of a fire in the event we had such a problem. Details are in APCI "Deluge System LOX Loading Facility", Safety Standard 630.2.6, Jan. 1964 (Doc. #99000055).

APCI, "Check List, Air Separation Plant, Operation", Safety Standard 610.1.5, February 16, 1961 (Doc. #99000218), has two items on the check list regarding spill hazards. One (Page 10) indicates the loading area pad is to be sloped to permit flow to the least hazardous area. The other (Page 9) questions, "Are there remote operating shutoff valves at locations where large quantities of LOX or liquid hydrogen are stored and failure of a tank would present an extreme hazard?"

APCI, "Air Separation Plant, Cryogenic Liquid Disposal", April 1962 (Doc. #99000047), and APCI, "Vaporizer, Cryogenic Liquid Disposal", Design Engineering Standard 514.6.2, May 26, 1961 (Doc. #99000015), are not directly applicable to spills and leakage but have some details on vaporizers and natural disposal.

We have not environmental warning and escape systems, therefore no detection; quantity and response time limits.

It is company and industry policy to keep all oxygen areas and systems free of incompatible materials and ignition sources.

"Handling of Low Temperature Fluids and High Pressure Oxygen", by F. Himmelberger, presented at the Aeronautical Industries Section Program of the National Safety Congress, Chicago, Ill., October 19, 1959 (Doc. #99000219), has some material on spills. All facilities have this article included in their Safety Manuals.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

D. Spills and Leakage

1. Drainage and Ultimate Disposal Arrangements

- a. At production plants the Industrial Gas Division is responsible for the conversion of transport equipment from one service to another (e.g. LOX to LIN) and for disposal of off-purity product. This general category of disposal would be intentional and would be performed in the following manner if the production facility has a vapor collection system. The liquid product would be transferred at a controlled rate into the plant tanker vapor collection system for vaporization and dispersal through a vent stack provided with a blower which safely disperses the vapor into the atmosphere. If a vapor collection system is not provided at the production facility, the liquid product is drained onto a clean gravel area at a controlled rate to avoid producing a large vapor plume and a large area with a high oxygen concentration.
- b. Safe venting and control of leakage during transfer of LOX product at consumer sites is achieved by eliminating the possibility of product from contacting combustible materials. It is IGD practice to install bulk oxygen storage systems in accordance with company criteria based on the applicable codes, NFPA #566, "Installation of Bulk Oxygen Systems at Consumer Sites", 1965 edition (Doc. #99000190). This code and Air Products' criteria requires that liquid oxygen be transferred over noncombustible surfaces, thus, any leakage of liquid oxygen or small spillage would be safely vaporized. The noncombustible surfaces referenced above are clean gravel or concrete. Where asphaltic paving or possible hydrocarbon on gravel or on earth are under the transfer hose connections or valving, an aluminum drip-pan is provided during the transfer operation. It has been Air Products' experience that the relatively small quantity of vapor associated with LOX transfer procedures do not pose a problem.

NFPA #566, 1965 edition has been revised in May 1971, in accordance with the "Amendments" to NFPA No. 566, (Doc. #99000191) and will be designated as NFPA #50.

- c. Gaseous oxygen storage systems are also covered by NFPA pamphlet #566; however, the problems of leakage are significantly less than with LOX.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

D. Spills and Leakage

2. Separation of Incompatible Materials and Ignition Sources
in Disposal Systems

NFPA #566 (Doc. #99000190) lists quantity distance criteria to maintain flammable and combustible storage at a safe distance from the oxygen bulk storage system. Similarly, ignition sources are restricted from the immediate area of the oxygen bulk storage system. It is the intent of the NFPA code to prevent storage of combustible materials and combustible structures at an inadequate distance from the storage system to preclude the exposure of the oxygen storage system to a fire.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

D. Spills and Leakage

3. Environmental Warnings and Escape Systems

Due to the practical maximum storage at consumer sites, perhaps 20,000 gallons of LOX, (average 2,400 gals) there is not a necessity for any specific or general requirements for environmental warnings and escape systems. Each oxygen bulk storage system is placarded with a warning "Oxygen - No Smoking or Open Flames."

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

D. Spills and Leakage

4. Detection: Quantity and Response Time Limits

Due to the practical maximum storage of 20,000 gallons of liquid oxygen with the average storage being 2,400 gals, a detection system is not provided at consumer facilities. NFPA pamphlet #566 (Doc. #99000190) requires that storage systems be located in well ventilated areas and places a restriction on the number of fire walls and locations of fire walls that may be used and would restrict ventilation (see Section 5-1-11).

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LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

E. Contaminants Accumulation

The procedures for solvent evaporation technique, and for extraction of ether soluble material and oil content determination are covered in:

Latshaw, D. R., "Oxygen Safety Review Check List",
May 4, 1971 (Doc. #99000217)

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

1. Production to storage, storage to system, storage to transport, transport to system.

Liquid production to storage is normally accomplished through gravity feed to low pressure tanks operating at 2-3 psig. Piping material may be austenitic stainless, copper or aluminum. Insulation is by rockwool in ducts for multiple lines or Foamglas for one or two lines. Liquid oxygen or nitrogen may be carried in a common duct. Inclusion of liquid hydrocarbons is not permitted. Small plants often utilize a vacuum jacketed transfer system or a batch transfer system to minimize heat leakage.

Storage to system often requires elevated pressures necessitating the use of centrifugal pumps. Storage to transport also requires pumping equipment due to operating pressures of the storage and the normal elevation of transport tankers. Transport to system is usually accomplished by pressurizing the tanker (to approximately 25 psig) or by on-board pumps for higher pressures.

Safety requirements relative to storage and loading areas are covered by Standard 607.2.1.1⁽¹⁾. Deluge systems are covered by Standard 630.2.6⁽²⁾.

2. References.

- (1) Ball, W. L., Plant Components, Storage, Converter System, and Cryogenic Liquids, APCI Safety Standards 607.2.1.1, April, 1962 (Doc. #99000048).
- (2) Kitson, F. K., APCI, The Protection Equipment, Deluge System, LOX Loading Facility, APCI Safety Standards 630.2.6, January, 1964 (Doc. #99000055).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

1. Production, Storage to System, Storage to Transport, Transport to System Loading and Unloading Procedures for Liquid Oxygen Transfer are Listed in Air Products' Safety Standards 635.19, Pages 3, 4, 5, and 6.
 - a. APCI, Loading and Unloading Operations, APCI Safety Standards 635.19, February 1968 (Doc. #99000194).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

1. Systems

Field Fabricated Cryogenic Liquid Storage Tanks.

APCI procedure for the design and fabrication of large Cryogenic Liquid Storage Tanks is covered in detail in the following references:

1. APCI Standard Specification for a Field Fabricated Cryogenic Liquid Storage Tank (Flat Bottom), APCI No. 99820A, September 15, 1971 (Doc. #99000341).
2. APCI Job Specification 310,000 Gallon Capacity LOX/LIN Storage Tank, APCI No. 71-2775-16.10-1A, September 16, 1971 (Doc. #99000342).
3. American Petroleum Institute, Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, API Standard 620, Fourth Edition, February 1970 (Doc. #99000343).
4. International Conference of Building Officials, Uniform Building Code, 1970 Edition, Volume I (Doc. #99000344).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

1. Systems

The following documents describe some of the APL oxygen transfer methods, several typical installations, and the Operations Department overhaul procedures for liquid pumps:

- (1) APL, Centrifugal Oxygen Compressor Manual, Hattingen Plant, APL (Doc. #99000410).
- (2) APL, LOX installation at Customer Sites, APL, I.G.D. Engineering Manual, No. EM 40-01, Rev. 0, July 19, 1971 (Doc. #99000411).
- (3) APL, Procedure for Filling Cryogenic Tanker by Pump at Carrington, APL, I.G.D. Engineering Manual, No. EM 50-01, Rev. 0, May 27, 1971 (Doc. #99000412).
- (4) APL, Procedure for Filling Cryogenic Tankers by Pump at Bracknell, APL, I.G.D. Engineering Manual, No. EM 50-02, Rev. 0, May 27, 1971, (Doc. #99000413).
- (5) APL, Procedure for Filling Cryogenic Tankers by Pump at Stoke-On-Trent, APL, I.G.D. Engineering Manual, No. EM 50-03, Rev. 0, May 5, 1971 (Doc. #99000414).
- (6) APL, Purge Procedure for Cryogenic Liquid Container, APL, I.G.D. Engineering Manual, No. EM 52-02, Rev. 0, June 3, 1971, (Doc. #99000415).
- (7) APL, Procedure for Cylinder Filling and Quality Control (Standard Purity Gases), APL, I.G.D. Engineering Manual, No. EM 55-01, Rev. 0, July 2, 1971 (Doc. #99000416).
- (8) APL, Procedure for the Installation of a Cryogenic Tank, APL, I.G.D. Engineering Manual, No. EM 60-01, Rev. 0, May 19, 1971, (Doc. #99000417).
- (9) APL, Operations Department, Overhaul Procedure, New Malden, APL C 155/9.5 (Doc. #99000418).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

2. Pipeline Transportation

O₂ pipelines are presently designed in accordance with the following:

- a. ANSI B31.8, Gas Transmission and Distribution Piping System, American National Standard Institute (Ex USA Standard), 1968 (Doc. #99000350).
- b. Title 49. Transportation, Part 192 - Transportation of Natural Gas and Other Gas by Pipeline: Minimum Federal Safety Standards -- Establishment of Minimum Standards, Federal Register, 35, No. 161, August 19, 1970 (Doc. #99000351).
- c. Title 49. Transportation, Part 192 - Transportation of Natural Gas and Other Gas by Pipeline: Minimum Federal Safety Standards -- Establishment of Minimum Standards, Filing of Inspection and Maintenance Plans, Federal Register, 35, No. 205, October 21, 1970 (Doc. #99000352).
- d. Title 49. Transportation Part 192 -- Transportation of Natural Gas and Other Gas by Pipeline: Minimum Federal Safety Standards -- Establishment of Minimum Standards, Odorization of Gas, Federal Register, 35, No. 220, November 11, 1970 (Doc. #99000353).
- e. Title 49. Transportation, Part 192 - Transportation of Natural Gas and Other Gas by Pipeline: Minimum Federal Safety Standards -- Establishment of Minimum Standards, Miscellaneous Amendments, Federal Register, 35, No. 223, November 17, 1970 (Doc. 99000354).
- f. Title 49. Transportation Part 192 - Transportation of Natural Gas and Other Gas by Pipeline: Minimum Federal Safety Standards -- Establishment of Minimum Standards, Corrosion Pitting; Notice of Public Hearing, Federal Register, 36, No. 126, June 30, 1971 (Doc. #99000355).

- g. Title 49. Transportation Part 192 - Transportation of Natural Gas and Other Gas by Pipeline: Minimum Federal Safety Standards -- Establishment of Minimum Standards, Requirements for Central Corrosion, Federal Register, 36, No. 126, June 30, 1971 (Doc. #99000356).
- h. Title 49. Transportation Part 192 - Transportation of Natural Gas and Other Gas by Pipeline: Minimum Federal Safety Standards -- Establishment of Minimum Standards, Extension of Time for Confirmation or Revision of Maximum Allowable Operating Pressure, Federal Register, 36, No. 176, September 10, 1971 (Doc. #99000357).
- i. Public Law 90-481
- j. Compressed Gas Association, Assembly of Industrial Practices Used for Gaseous Oxygen Transmission and Distribution, CGA Docket 70-11, Third Draft, March 22, 1972 (Doc. #99000345).

Liquid oxygen transfer systems are designed in accordance with:

ANSI B31.3, Petroleum Refinery Piping, American National Standard Institute (Ex American Standard Association), 1966 (Doc. #99000347).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

2. Pipeline Transportation

APL Oxygen pipeline design concepts and criteria are described in the following documents:

- (1) APL, Oxygen Pipelines, APL Engineering Standard LS.30/1, Rev. 0, July 1, 1970, (Doc. #99000404).
- (2) APL, Design and Safety Standards for Carbon Steel Gaseous Oxygen Transmission Lines, APL Engineering Standard LS 30/2, Rev 1, December 1, 1970, (Doc. #99000405).
- (3) APL, Piping Selection Sheet-Carbon Steel-Warm Oxygen Service 150 PSIG (CSO 1.5), APL Engineering Standard LS.31/1, Rev. 0, June 12, 1970, (Doc. #99000406).
- (4) APL, Piping Selection Sheet-Carbon Steel-Warm Oxygen Service 275 PSIG (CSO 2.7), APL Engineering Standard LS.31/2, Rev. 0, January 29, 1970, (Doc. #99000407).
- (5) APL, Piping Selection Sheet-Carbon Steel-Warm Oxygen Service 500 PSIG (CSO 5.0), APL Engineering Standard LS.31/3, Rev. 0, June 12, 1970, (Doc. #99000408).
- (6) APL, Piping Selection Sheet-Carbon Steel-Warm Oxygen Service 720 PSIG (CSO 7.2), APL Engineering Standard LS.31/4, Rev. 0, June 12, 1970, (Doc. #99000409).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

2. Road, Railroad, Barge, and Pipeline Transportation

a. Pressure Relief

The majority of relief devices on LOX tankers and LOX railcars at Air Products have a set pressure of 25 psig and a road safety relief valve set for 15 psig. Several tankers also have safety relief valves with a set pressure of 40 psig and several pumpers have a set pressure of 80 psig. Rupture discs are also provided on the above cryogenic transport equipment which are rated for approximately 1-1/2 times the safety relief valve setting. The relief devices for tankers are designed in accordance with the criteria listed in CGA Pamphlet Number 341 "Tentative Standard Insulated Tank Truck Specification CGA-341 For Cold Liquefied Gases" 2nd Edition, 1970, (Doc. #99000195).

Gaseous oxygen tube trailers containing D.O.T. tubes are provided with frangible discs in accordance with CGA Pamphlet Number S-1.1 "Safety Relief Device Standards, Part 1 - Cylinders For Compressed Gases" 5th Edition, 1969, (Doc. #99000196).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

2. Road, Railroad, Barge, and Pipeline Transportation

b. Contamination Control

Contamination control is insured by Air Products' Quality Assurance Program which monitors on a monthly to four month basis, the product produced at the production facilities and in storage at the cylinder filling facilities. This program is described in detail in the following documents:

- (1) APCI Quality Control Program, District Operations Manual, Section 6.3, July 1965 (Doc. #99000223).
- (2) Scott, D. J., "Analyses Required on Quality Control Samples", May 10, 1968 (Doc. #99000224).
- (3) Ent, W. L., "Revisions to IGD Quality Assurance Cost Procedures", including "Schedule for Submitting Routine Product Samples", October 17, 1966 (Doc. #99000225).
- (4) APCI Analysis Requirements Summary, District Operations Manual, Vol. I, Section 6.3.2, March 1970 (Doc. #99000226).

Assistance is rendered to customers to insure that the customer system is suitably cleaned for oxygen service prior to introduction of oxygen into a new system.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

2. Road, Railroad, Barge and Pipeline Transportation

c. Oxygen Dispersal From Vents and Lines

Liquid oxygen tankers were initially designed with vents extending down to the rear or forward of the control cabinet. It was believed a number of years ago that this was the safest means of disposing of venting oxygen. Within the past several years, design of new tankers have safety relief device vents directed up and back to vent oxygen at an approximate elevation of eight feet above grade. This has substantially reduced the concentration of oxygen enriched atmospheres close to the ground and provided better dispersal of the vapor into the atmosphere.

Gaseous oxygen tube trailers are provided with vent stacks which discharge oxygen straight up into the air above the height of the highest tubes on the tube trailer. Weather protection caps are installed on the vent stacks.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

2. Road, Railroad, Barge and Pipeline Transportation

d. Vehicle Accident Procedures

Accident procedures are included in APCI, Fire Extinguishment, APCI Safety Standards 635.30, pages 1, 2, and 4, February 1968 (Doc. #99000197).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

2. Road, Railroad, Barge and Pipeline Transportation

e. Vibration and Controlled Sloshing

Vibration of tankers in over the road use is minimized by certain inherent factors in tanker design and by careful selection of the running gear. The inner tank vibration is dampened by perlite insulation and by the inner tank supporting system utilizing phenolic materials as thermal barriers. Piping is guided to permit contraction and eliminate unwanted movement resulting from road vibration. Careful selection of commercially available running gear to obtain minimum vibration transmitted to the chassis.

A number of years ago liquid oxygen tankers were provided with approximately three transverse baffles and one additional longitudinal baffle. In striving to achieve lightweight designs and as the longitudinal baffle did not appear to contribute significantly to tanker operation, it has been deleted from recent designs with no detectable adverse effect. The more recent designs include baffles that are a perforated conical design with a hole in the center with an approximate 50 percent open area. A design to minimize the effect of sloshing and obtain maximum tanker capacity with lightweight design is difficult.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

3. Malfunctions and Failures

- a. Oxygen pressure gauge failure on March 23, 1964 in Emmaus Plant. Questionable history and the gauge used because it had not been labeled for oxygen service. Man received bruise on left hand. Refer to memo, Schmoyer, W. W., "Specialty Gas Gauge Failure," April 13, 1964 (Doc. #99000257).
- b. Hose rupture and fire on test gauge equipment at our Shakopee, Minnesota cylinder fill facility on June 9, 1968. Rubber hose should not be used in oxygen service. Man received second degree burns to his face and arms. He was wearing safety glasses. Refer to memo, Hubbs, M. H., "Test Gauge Equipment Failure, Shakopee, "June 12, 1968 (Doc. #99000284).
- c. APCI, Memo by B. J. Berrettini, "LOX Pump Fires and Explosions," dated June 26, 1970 (Doc. #99000258), Summarizes causes and similarities of seven different APCI/APL transfer pump energy releases.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

3. Malfunctions and Failures

The following information identifies several APCI incidents involving oxygen transfer equipment or instrumentation. APCI reports and documents covering these incidents more fully are also identified by date and Document #.

| <u>Date</u> | <u>Doc. #</u> | <u>Author</u> | <u>Equipment</u> | <u>Description</u> |
|-------------|----------------------|---------------------------|------------------|--|
| 6/28/61 | 99000274 | E. Kehat | Gauges | Tests on orifices to be installed in oxygen service gauges to prevent personnel injury in the event of an energy release or over-pressure rupture of gauge bourdon tube. |
| 8/2/61 | 99000275 | F. K. Kitson | Gauges | Report of requirements for purchasing new gauges and modifications of old gauges to protect personnel in the event of a rupture. |
| 1/64 | 99000049 | W. W. Schmoyer | Vacuum System | Safety Standard 607.2.2.5 on cylinder evacuation system to prevent contamination of fill manifold and cylinders. |
| 7/65 | 99000270 | W. W. Schmoyer | Regulator | Report on operation, use, hazards and general accident causes of regulators. |
| 12/15/67 | 99000277 99000278 | W. L. Ball M. H. Hubbs | Loading | Two reports on an incident whereby a loader's eye was probably saved by glasses when a hammer chip shattered his glasses when tightening a liquid connection. |
| 6/4/68 | 99000281 | M. Hubbs | Cylinder Fill | Cylinder safety blew on fill manifold. Force broke pig-tail and fill manifold, breaking adjacent cylinder loose. |

| <u>Date</u> | <u>Doc. #</u> | <u>Author</u> | <u>Equipment</u> | <u>Description</u> |
|--------------------|----------------------|----------------|------------------|--|
| 12/30/68 | 99000265 | H. H. Master | Pumps | Competitor pump fire had indicated foreign material may have been cause. Reviews our position and specifies suction screens be installed where still necessary. |
| 1/24/69 | 99000266 | H. H. Master | Pumps | Same as above but directing and instructing managers to accomplish screen installations. |
| 2/27/70 | 99000273 | H. H. Master | Meter | Near miss report where incompatible material was used in a ring balance meter in oxygen service and action taken to check and eliminate existing and future problems. |
| 1/19/71 | 99000276 | F. K. Kitson | Vacuum System | Vacuum system arrangement to prevent water from getting into cylinders where Nash water-seal compressor is utilized. |
| 1/26/71 2/19/71 | 99000267 99000268 | R. D. Stompler | Pumps | Review reasons and status of modifications to Operations Department pump to prevent recurrence of a similar pump failure at Puerto Rico. Modifications to lube system addition of suction screens and protective barriers. |
| 2/8/71 | 99000279 | H. H. Master | Loading | Driver pulled away from load area with hose still connected. Stopped in time to prevent line or hose breakage. |

February 3, 1972

IIF3-3

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

3. Malfunctions and Failures

The following information identifies several incidents which occurred with other oxygen equipment together with reports and documents covering these incidents in greater detail.

| <u>Date</u> | <u>Doc. #</u> | <u>Author</u> | <u>Equipment</u> | <u>Description</u> |
|-------------|-----------------------|----------------------------|------------------|--|
| 6/26/61 | 99000259 | S. H. Duffala | Compressor | Two reports on the 6/21/61 Linde oxygen compressor fire at Great Lakes Steel. Three men were killed. Since all three on site were killed, there is some question on the cause, but it is known they were having trouble with the compressor. |
| 7/7/61 | 99000260 | W. L. Ball | | |
| 8/62 | 99000280 | M.C.A. | Pump Filter | Report of a missile pad incident where contaminants in a pump filter were probably initiated by a foreign particle at high velocity. The resulting release caused a massive LOX spill. |
| 10/21/63 | 99000261 99000261A | W. L. Ball J. J. Rendos | Pump | Reflux pump on the Airco plant at Butler, Pa. exploded and killed one man. Piping and pump believed to have contaminants. |
| 1965 | 99000262 | S. W. Cowles | Pumps | 1965 AIChE meeting paper on four separate fires experienced at Armour Agricultural Chemical Company. |
| 1966 | 99000263 | J. J. Rendos | Pumps | Report on cause of two pumps fires experienced by Airco on 5/21/66 and 5/23/66. |

| <u>Date</u> | <u>Doc. #</u> | <u>Author</u> | <u>Equipment</u> | <u>Description</u> |
|-------------|---------------|---|------------------|--|
| 12/29/67 | 99000264 | H. H. Master | Pipeline | Details were limited on an oxygen pipeline filter fire at a steel mill in India where six people were killed. |
| 6/70 | 99000269 | H. Bauer W. Wegner K. F. Windgassen | Pumps | Article from Cryogenics on tests made for causes of pump fires. Includes mechanical problems, relation of various metals to combustion possibilities and intensity, and drop hammer tests on chips of metals and assembly materials. |

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

3. Equipment Malfunctions and Failures

The two main categories of machinery used for oxygen transfer are compressors and pumps. Malfunctions and failures with these devices have led to numerous design features and operating techniques to prevent failures or at least to prevent serious damage and personnel injury. Most failures have been diagnosed sufficiently to enable action to be taken to prevent recurrence, however, some failures have been unexplained and the resulting action has been protective rather than preventive. Some potential failures are impossible to prevent and these cases are necessarily handled by protective measures.

Materials of construction for compressors and pumps often are not completely compatible with oxygen and under certain conditions will burn. In most instances there is no substitute material which is both compatible with oxygen and which will satisfy the design requirements. In some instances the cost of more compatible materials is prohibitive. Silver is used in limited quantities for shaft seals with some makes of compressors but the high cost has caused some manufacturers to use cheaper less compatible materials. Compressors cast of bronze would be more compatible with oxygen than when cast of iron but the costs and manufacturing difficulties prevent this selection.

Oxygen Compressors Most compressors used by industry for oxygen have been either reciprocating or centrifugal. Generally reciprocating compressors are used for small to moderate flow rates where low to moderate pressures are required. For high flow rates and high pressure a centrifugal and reciprocating compressor are often used in series. Centrifugal compressors require at least 500 CFM actual flow at the last stage of compression for reasonable performance and are generally limited to about 500 psig discharge pressure. Applications with less flow or with higher pressures are usually accommodated with reciprocating compressors.

Potential equipment malfunctions and failures are designed out of the compressor as much as possible during the procurement and design stage. Not all compressor manufacturers are knowledgeable on oxygen compressors and thus the selection of potential suppliers is the first step. Proper purchasing specifications are necessary

to fully describe the duty and design features required. Oxygen compressor suppliers have certain standard features of construction but rely on customer specifications to complete the design. Customer specifications aside from process duty requirements are basically experience factors to be applied to the compressor design. The compressor supplier does not usually receive full feed back information on the operation of the compressor as does the operator. Thus the compressor operator reflects experience factors in specifications for new equipment.

Reciprocating Compressors Reciprocating compressors have been used for many years in oxygen service but until recent years mostly small high pressure units. Prior to the advent of Teflon, and similar materials, for piston rings and piston rod packing most compressors were operated with a soap-water solution for lubrication or used carbon-graphite sealing materials and wear parts. Also in use has been the labyrinth type piston compressor and the diaphragm type compressor.

Present day reciprocating compressors are mostly Teflon ring construction of labyrinth piston construction with a few diaphragm compressors used for low flow high pressure applications.

Some of the notable malfunctions and failures on reciprocating oxygen compressors in recent years which have been "designed-out" are listed below:

Incorrect assembly of compressor cylinder valves such that intake valves were installed in discharge ports. This condition results in recompression in the cylinder and generates excess heat and a high potential for a fire. APCI specifications require a valve design such that an intake valve will not fit into a discharge port.

Foreign objects entering cylinders have caused scoring of cylinders with resultant excess heat and potential fire. Impacting of foreign objects could also cause a fire. APCI specifications require line filters in front of compressors to prevent entrance of foreign objects.

Foreign objects can also be in the form of broken parts from the compressor itself such as valve parts falling into the cylinder. APCI specifications require vibration switches which function on high acceleration or "shock" forces and which shut down the compressor. Experience has shown that the initial impact of the piston with the foreign object causes less damage than the sub-sequential damage caused by continued operation. Continued operation is likely to cause heat and a resultant fire. For this reason vibration switches must be set to trip the compressor

instantly, upon sensing a malfunction, in order to be effective.

Non-lubricated cylinders using Teflon or similar materials for self-lubricating rubbing or sealing parts are subject to unpredictable wear rates. Since the self-lubricating material generally separates moving metal parts the wearing out of the material can cause metal to metal contact with high friction heat and potential fire. Self-lubricating piston rings are sometimes supplied with an expansion ring to help hold the piston ring against the cylinder bore. In the event of piston ring failure or high wear the expander can come in contact with the cylinder bore. Since the expander is usually spring steel it can cause scoring and heat and a potential fire. APCI specifications prohibit the use of expanders.

Piston rider rings which support the weight of the piston and guide the piston in the cylinder can wear and allow metal to metal contact. Constant monitoring of this wear is difficult and requires disassembly of the compressor. APCI specifications prohibit the use of expanders.

Piston rider rings which support the weight of the piston and guide the piston in the cylinder can wear and allow metal to metal contact. Constant monitoring of this wear is difficult and requires disassembly of the compressor. APCI specifications require a rider band design that will not operate as a seal ring and thus should not wear out before the normal piston rings. Horizontal compressors are specified to have a detector to sense a lowering of the piston rod. The lowering of the rod will indicate wear of the piston rider rings or wear of the crosshead and shows inspection is necessary.

Temperature indication within the compressor system is very useful to detect problems. Interstage gas temperature indicators will detect cooling problems, compressor cylinder valve problems or piston ring leakage. On compressor cylinders with many valves an individual temperature pickup is mounted on each valve to detect a broken or leaking valve.

Centrifugal Compressors Centrifugal compressors are being used more in recent years due to larger volumes of gas to be transferred. High rotating speeds are necessary with centrifugal compressors since the pressure is developed by kinetic energy. Because of the high rotating speeds, accidental rubs between the rotor and case are likely to produce a fire.

The materials used for construction of a centrifugal compressor are generally a compromise between oxygen compatible materials and materials having proper mechanical design properties. The compromise materials must be such that they are compatible with oxygen in the normal mode of operation but may not necessarily

be compatible in the event of a malfunction of internal rub during operation. The prime example of this condition is the common use of stainless steel alloys for rotors and steel or iron alloys for the case. A high velocity rub between the impeller and the case has caused several fires wherein the impeller has been consumed by fire and the case has burned through. Since compatible materials are not available or are prohibitively expensive the compressor is designed to minimize the chances of a rub.

Probably the greatest cause for a fire in a centrifugal compressor is having a rub between an impeller and the case. The compressor design should be such that if a rub does take place the rub should occur at a small diameter section where the rubbing velocity is low. Shaft seals are generally a labyrinth type and do experience rubs since they are designed for small running clearances. These seals are small diameter and of thin cross section with narrow edges such that a rub will generally not cause a fire. The labyrinth blades dissipate the friction heat from the rub adequately to keep the temperature of the materials below their ignition point. Conversely a rub of the impeller at high velocity at a massive section will concentrate the friction heat and ignite the rubbing materials.

APCI specifications require materials of construction and certain running clearances to help design out potential fire causes. Additional preventive measures are taken by instrumenting the compressors to detect malfunctions as they develop and thus take corrective action before a rub takes place. Several of the more important instruments in use are:

1. Temperatures - All interstage gas temperatures before and after intercooling, bearing temperatures and cooling water temperatures. All of these temperatures indicate the condition of the compressor and are of primary importance when used to indicate a change taking place.

High gas temperatures are not necessarily harmful in themselves but the temperature effect on the compressor parts could cause thermal deformations and resulting problems. Of importance is to determine the cause of the temperature rise. APCI connects the compressor discharge temperature indicator to alarm and to shut down the compressor.

Bearing temperatures are an important indicator of bearing performance. Bearings generate considerable heat and a bad bearing will generally increase in temperature. The bearing heat is removed with the circulating lubricant and thus the bearing temperature also gives an indication of lubricant flow.

2. Vibrations - Rotor vibrations relative to the compressor case and rotor axial position relative to the case are constantly monitored and the instruments designed to alarm and to shut down the compressor. The rotor vibrations are very indicative of the mechanical condition of the compressor. The vibrations will indicate rotor unbalance or looseness, rubs between the rotor and case, bearing problems, and drive coupling problems. Any vibration increase from the normal acceptable level is reason for investigation. APCI standard procedure is to have the vibration instruments sound an alarm at a vibration level 0.5 mils above normal and shut down the compressor at a level 1.5 mils above normal. If a gradual vibration level increase is occurring the compressor will be manually shut down at a level of 1.0 mils above normal.

Axial position of the rotor in the case is maintained by the thrust bearings. A shift of the rotor can allow side contact of the impeller in the case with the previously mentioned fire potential. The position instruments are set to alarm and to shut down the compressor if the rotor moves beyond the limits normally allowed by the thrust bearing.

Vibration monitoring equipment of the proximity probe type, which does not touch the observed shaft, is relatively new and has been very helpful in diagnosing high speed centrifugal compressors. APCI has been able to diagnose many potential problems and perform corrective work prior to a failure with the aid of these vibration sensors. We believe several previous unexplained compressor fires could have been prevented through the use of this type equipment. Because of their importance all APCI centrifugal oxygen compressors are now equipped with radial and axial vibration monitors.

3. Anti-Surge Control - Centrifugal compressors are subject to a condition called surge. Surge occurs when the back pressure imposed on the compressor is greater than the compressor is capable of producing and occurs at different pressure values depending upon the flow rate through the compressor. When surge occurs there is a rapid pressure change within the compressor that usually results in a change in axial force on the rotor and can also reverse the direction of thrust on the bearings. Thrust bearings are usually capable of withstanding repeated surging but it is an aggravated condition and there are many cases of compressor failure caused by surging. Since the surging causes an axial movement a side rub on an impeller is likely and on an oxygen compressor it would probably cause a fire.

All APCI oxygen compressors are equipped to automatically vent or bypass the compressor discharge flow at operating conditions approaching surge. Additional vents will also automatically vent to atmosphere in the event of a shut-down so that the stored volume of gas in the compressor will vent quickly enough to prevent any surge conditions while the compressor is slowing down.

Oxygen Pumps Most pumps used by industry for oxygen have been either reciprocating or centrifugal. Generally reciprocating pumps are used for small to moderate flow rates and for higher pressures. Centrifugal pumps are used for most all flow rates where low to moderate pressures are required.

Oxygen pumps, both reciprocating and centrifugal, are a specialty item and are available from a limited number of suppliers. The special design features, cleanliness requirements and relatively small sales volume makes them unprofitable for most pump suppliers.

Materials of construction are similar for both types of pumps and fall into the category of acceptable low temperature materials, namely nickel alloys, copper alloys and aluminum. Generally the nickel alloys are used where high strength is required, copper alloys where rubbing contact is expected and aluminum where light weight is required. The copper alloy generally used is bronze and is the most compatible with oxygen of the low temperature metals. Nickel alloys are generally the 300 series stainless steel or Monel.

Oxygen pumps are generally a simple device with few controls or instruments. Most pumps have only a suction and discharge pressure gage to monitor their performance. Oxygen pump usage is mostly for transfer operations where the liquid oxygen is transferred from one storage vessel to another and often from a pressure vessel to a higher pressure vessel or pipe line. This transfer duty is mostly on intermittent operation.

Malfunctions and failures of oxygen pumps are probably due more to the intermittent mode of operation than for any other reason. Starting and stopping of any mechanical device is generally considered detrimental to its long term performance, but with oxygen pumps this condition is greatly exaggerated. Some of the past failures of record and reasons for failure are listed below and it can be seen how intermittent operations affects the pump. Not all failures have been explained and this fact indicates the need for more instrumentation and controls on oxygen pumps. APCI is now working on new standards for oxygen pumps and will attempt to achieve better pumps and better operating techniques.

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IIF3-4 (continued)

Centrifugal Pumps A centrifugal pump is usually trouble free so long as the shaft bearings and shaft seals are intact. Many problems can develop to cause failures and these will be discussed; but we consider bearings and seals as the greatest problems.

1. Bearings - The pump impeller must rotate at a rapid rate in the pump housing in order to develop pressure. Accidental contact between the rotating impeller and the pump case will cause friction heat and even in a liquid oxygen environment can cause a fire. Most known fires and explosions of centrifugal oxygen pumps were due to impeller rubs and most of these rubs were due to failed bearings. Very few pumps are installed with any instrumentation to monitor the condition of the bearings.

Low speed pumps 3600 RPM and below generally have grease lubricated bearings and are not a general problem when properly maintained. Higher speed pumps are either grease lubricated or oil lubricated and do have bearing problems. Oxygen pumps generally use oxygen compatible fluorinated lubricants which are inferior to premium petroleum lubricants and do not adequately protect against rust and corrosion within the bearings. Pumps can rust in the bearing area while inoperative and fail prematurely during operation. Fluorinated lubricants are also subject to breaking down and forming acidic products when subjected to excess heat and moisture. These conditions can develop in a pump bearing housing with certain bearing failure as a result. Most pumps use a small amount of lubricant and as a result have very little reserve supply to account for any leakage. Oil lubricated pumps rely on circulation of lubricant with most pumps not equipped to monitor the lubricant flow.

Some pumps have their bearings lubricated with the pumped liquid oxygen and it is critical to maintain liquid in the bearings. The friction heat of the bearings will tend to vaporize the liquid and the bearings can fail under this condition. For this type pump, it is critical to maintain sufficient NPSH to prevent cavitation and thus prevent flashing in the bearings.

Temperature indicators are a good device to monitor the condition of bearings not lubricated with the pumped liquid. Bearings generally increase in temperature as they wear and will rapidly increase in temperature while failing. High temperature switches are a good device to detect bearing failure and to shut down the pump prior to an impeller rub occurring.



2. Shaft Seals - Oxygen pump shaft seals are generally exposed to the atmosphere which allows oxygen leakage to safely dissipate. Since the shaft seal gets cold while pumping it can condense moisture which will subsequently freeze and form ice deposits. Intermittent operation allows thawing and refreezing which allows water to penetrate the seal and freeze inside the seal surfaces which can cause seal failure. A dry atmosphere in the seal area is beneficial and if heated, affords additional benefit. Dry heated nitrogen is used to blanket the seal area on installations where nitrogen is available. Installations such as on trailers where dry gas is not available can expect more seal problems.
3. Suction Screens - Foreign objects entering the pump suction can become lodged between the impeller and case and cause friction heat and fire. All APCI pumps are supplied with suction screens to keep foreign objects from entering the pump.
4. Cleanliness - Oxygen pumps, as well as all oxygen handling equipment, must be clean. Too often mechanics are careless and a pump fire or explosion results.
5. Faulty repair - Incorrect assembly of a pump can readily allow impeller rubs. Oxygen pump maintenance and overhaul is best performed at central maintenance depots or by the pump manufacturer to assure proper assembly and cleanliness.

Reciprocating Pumps Reciprocating pumps are used almost exclusively where high pressures are required for cylinder filling and high pressure storage systems.

The reciprocating pumps operate at slower speeds than centrifugal pumps and have much slower rubbing contact velocity in the liquid oxygen area. Reciprocating pumps generally operate with a plunger in a barrel with packing or seal rings on the plunger to prevent leakage. In the event of malfunction or excess wear accidental rubs between the plunger and barrel rarely create enough friction heat to cause a fire or explosion. Material selection for the cold end of the pump is important so as to have materials which can best tolerate rubs without creating excess friction heat and metal to metal galling. Bronze alloys are preferred over stainless steel for this consideration.

Pump packing material in recent years has been predominantly Teflon alloyed with various stabilizers and additives. Prior to Teflon, carbon-graphite mixtures with asbestos were used and are still used to a lesser extent.

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IIF3-4 (continued)

Cleanliness and proper packing installation are important since the contact area of the packing to the plunger is where the most heat from friction can be expected and where a fire or explosion is most likely to initiate. Operation of a liquid oxygen pump on some other cryogenic fluid such as liquid nitrogen or liquid argon can present a hazard when put back on liquid oxygen service, unless the pump is disassembled and properly cleaned. Minute particles of packing, especially carbon particles, are formed during operation and while on oxygen service are gradually oxidized with no problem. If these particles are formed in a non-oxygen environment and then later exposed to an oxygen environment they will oxidize rapidly and together can result in excess heat with a potential fire or explosion.

Reciprocating pump valves can be a maintenance problem but do not normally present a safety hazard in themselves. Valve failure will cause the pump to stop pumping, however, and continuous operation can develop excess heat within the pump since no liquid flow is present to carry away the friction heat. A discharge pressure switch or flow measuring device set to shut down the pump can monitor against this occurrence.

LOG OF FIRES IN CENTRIFUGAL GASEOUS OXYGEN COMPRESSORS

Mid to Late 1950's - Failure somewhere in South Africa, presumably a Brown Bovari compressor.

1959 - January 15 - McClouth Steel, Detroit, Michigan

| | |
|---------------------|-------------|
| Manufacturer | Carrier |
| Low Pressure Case: | |
| Model | 18 H 3501 |
| Capacity | 4,080 cfm |
| Discharge | 94.5 |
| High Pressure Case: | |
| Model | 18 H 3501 I |
| Capacity | 620 cfm |
| Discharge | 399.4 psia |
| Speed | 9500 rpm |
| Total BHP | 1668 |

The fire occurred in the high pressure casing between the last stage wheel and the balancing piston. The high pressure case burned through and the flames melted and burned through the low pressure cast iron case. The carbon steel shafts apparently were heavily damaged but the cast iron diaphragms showed no evidence of burning. The journal and thrust bearings were not damaged appreciably and apparently did not enter into the combustion reaction.

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IIF3-4 (continued)

1959 - July 10 - Wyandotte Chemical, Geismar, Louisiana

| | | |
|-----------|------------|----------------------|
| Clark | - Type IM8 | 2 machines in series |
| Capacity | | 3150 cfm at 75°F. |
| BHP | | 1050 |
| Speed | | 9500 rpm |
| Discharge | | 225 psig |

The reaction was confined to the discharge end seal area only. The previous day leakage was found in a diaphragm water nipple, which was repaired during outage of about 30 hours due to process trouble. Fire occurred during startup when oxygen was bled into the machine after 3-hour run-in with nitrogen.

It is speculated that corrosion products caused by water leakage caused frictional heating and ignition in the balance piston area.

1960 - Montecatini, Novaro Chemical Plant

| | |
|--------------------|---|
| Make | Demag Turbo Blower (purchased in 1952) |
| Stages | Three |
| Inlet Pressure | 1 atmosphere |
| Discharge Pressure | 2.5 atmospheres |
| Speed | 10,500 rpm |
| Speed of Motor | 3,000 rpm |

A fire reportedly occurred "some time ago" at the referenced facility. The only data available concerns the design of the machine.

1964 - July 17 - Wyandotte Chemical Company, Geismar, Louisiana

Reaction occurred in same machines involved in failure of 1959.

The fire in the oxygen compressor was associated with explosions and fires in other sections of the process system. It is believed that ethylene oxide backflowed through a connection into the process air stream to the air separation plant, went through the air separation plant and into the oxygen compressors. The low pressure case received only minor damage, but the high pressure case was blown apart. The suction bottle of the low pressure machine was split open and the top heat blown about 250 feet away.

1965 - September 26 - Mingo Oxygen Company, Mingo Junction, Ohio

Fire occurred in piping associated with the compressor but did not involve the compressors themselves.

1967 - December - Poland

A Demag unit reportedly failed shortly after startup. Cause believed to be improper/inadequate cleaning after long period of storage.

1968 - Knapsack Gresheim (Division of Messer), Duisburg, West Germany

At this facility five Brown Bovari centrifugal oxygen compressors discharge into a common oxygen main. On a normal shutdown of one of these machines, which had been in operation for seven years, the discharge check valve failed to operate. The operators also had failed to close the manual discharge block valve, which normally is done prior to shutting down the compressor. After coming to rest, the backflow of oxygen caused the machine to rotate backwards. As the lube oil pump does not operate with reverse rotation of the shaft, the main bearings and thrust bearings received no oil and began to overheat, damaging the bearings and the silver labyrinth packings of the sealing glands and impellers. Excessive heating in the bearings vaporized the remaining oil, finally resulting in an air-oil vapor explosion and fire.

Upon closing the discharge block valve, rotation of the machine ceased and the air-oil fire was put out by the operators. Damage was confined to the bearings and labyrinths. Oxygen was not involved in this reaction, which is of a type that under similar circumstances could occur on a compressor regardless of the material being compressed (whether oxidant, fuel or inert).

1968 - June 17 - Shell Chemical Company, Geismar, Louisiana

| | |
|---------------------|---------------------|
| Manufacturer | Elliott - 24 HB |
| Discharge Pressure | 265 psia |
| Capacity | 1365 acfm (500 T/D) |
| BHP | 945 |
| Speed | 19,403 rpm |
| Bearing Lubrication | Water |

This unit was the high pressure case of a two-case train. The unit had been in steady operation for a period of more than four weeks. There was no indication from the operating records of a change of conditions (loss of power, surging, vibration, pressure or temperature change).

Inspection of the casing revealed the most extensive damage in the area of the first stage impeller discharge. The casing



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IIF3-4 (continued)

had been burned through in four places in the plane of the first stage discharge, and the interstage diaphragm was almost completely consumed. Although the second stage impeller was severely damaged, there was very little evidence of combustion in the second stage. The shaft was not burned nor were the journal bearings or thrust bearings.

1968 - June 27 - Air Products and Chemicals, Inc., Sparrows Point, Maryland

Clark IM3 (High Pressure Case). The inboard journal of the high pressure case is believed to have failed during roll-down of the compressor, metal-to-metal rubbing in the interlocking labyrinth at the balance drum of the high pressure rotor ensuing and causing ignition. The fire broke through at both ends of the high pressure casing and several places in the balance piping. The rotor and high pressure case were damaged beyond repair.

1968 - September - Mekog, Holland

Fire reported in GHH oxygen compressor.

1968 - October - Shell Chemical Company, Geismar, Louisiana

The new Elliott compressor, replacing the unit that burned in June 1968, caught fire and was destroyed the first time an attempt was made to put it onstream.

1968 - December 14 - Air Products and Chemicals, Inc., Weirton, West Virginia

In Clark IM7-3 evidence was found, during regularly scheduled maintenance work, of limited fire damage which possibly occurred during an earlier startup.

1968 - December 27 - Airco, Bethlehem, Pennsylvania

A Demag high pressure casing had fire in discharge volute of last stage.

1969 - Nippon Sanso, Japan

A Demag unit reportedly failed early 1969 or late 1968 in a manner similar to the second Airco Bethlehem fire.

1969 - March 18 - Air Products and Chemicals, Inc., Middletown, Ohio

A Clark low pressure case, fire beginning in 4th stage, burning through into 2nd stage. Fire occurred during a scheduled shut-down of the compressor.

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IIF3-4 (continued)

1969 - April 4 - U. S. Steel, Chicago, Illinois

A Clark oxygen compressor in a Linde plant.

1969 - April 15 - Airco, Bethlehem, Pennsylvania

Fire in same Demag machine that had a fire in December 1968.

1969 - June - August Thyssen Hütte, Duisburg

A GHH centrifugal compressor system. Fire reportedly occurred in the last intercooler causing damage to the intercooler and steel foundations. No damage to the compressor.

1969 - December 5 - Air Products and Chemicals, Inc., El Segundo, California

A Clark high pressure case, Type 161 B 4/4, operating at about 1275 psig, caught fire while being run-in on initial startup.

196? - India

A Clark oxygen compressor reportedly was involved in a serious internal fire at a plant that was being erected by Constructor John Brown (England).

196? - Linde Division of Union Carbide, East Chicago, Indiana

An incident occurred with a Clark 3M4-2MF, 400,000 scfh to 195 psig oxygen compressor.

Machine went down on a general power failure that also shut down drix pumps and the pipe line. Because of cold weather, the fluid in the dash pot on the discharge check valve froze or became so viscous that the valve failed to close. After an elapsed time of about 20 minutes, power to drix pumps was reestablished, the pumps started up, and pressure in the product line was reestablished. Power to the compressor motor and lube oil pumps was not yet on. As the check valve was not closed, oxygen back flowed into the compressor, rotating the rotors backward and without oil to the bearings.

An operator near the compressor noticed the startup of the unit and went to close the manual valve. As this valve was difficult to operate, the man had to close the next valve downstream.

A puff of smoke came out of the lube oil console and one oil drain burned - otherwise the fire was contained inside the case. All seals were out because of friction and fire.

196? - Linde Division of Union Carbide, Gary, Indiana

The Clark oxygen compressor was steam-turbine driven and it was felt that in at least one startup the operators were slow bringing the machine through a critical speed. There was no outward manifestation of difficulty, but when it became necessary to open the case for maintenance reasons, they discovered excessive wear on an interstage labyrinth seal and evidence of contact between the seal and the shaft sleeve, and burning on the shaft sleeve which was stainless instead of monel.

1970 - April - Galatz, Rumania

A fire reportedly occurred during the first week of April on a Demag oxygen compressor. Machines have been running two years. Strainer was installed on these machines made of 18/6 stainless steel in suction line and strainer completely disintegrated, went through machine with resulting fire and destruction of two casings in a three-casing train. The strainers were apparently installed against Demag's advice. No injuries.

1970 - April - Auguste Thyssen Chemical Works near Oberhausen, West Germany

A fire reportedly occurred in a GHH compressor during the first week of April.

References:

1. APCI General Specification for Cleaning for Oxygen Service, APCI No. 550-SD-27A, Revision E6T41, May 15, 1963 (Doc. #99000335).
2. APCI General Specification for Centrifugal Compressors, APCI No. 550-SD-16A, Revision B8551, April 15, 1965, (Doc. #99000336).
3. APCI General Sepcification for Reciprocating Compressors, APCI No. 550-SD-1A, Revision E7361, March 9, 1964 (Doc. #99000337).
4. APCI Construction Specifications. General Construction and Equipment Erection in Oxygen Compression Systems, El Segundo, California, APCI Section 200 to 200.20 incl., Revision November 17, 1969 (Doc. #99000338).
5. APCI, Machinery Field Testing and Reciprocating Oxygen Compressors, APCI Design Engineering Standard 551.1.9.1, February 3, 1971 (Doc. #99000026).

6. APCI, Machinery Field Testing and Centrifugal Oxygen Compressors, APCI Design Engineering Standard 551.2.8.1, February 3, 1971 (Doc. #99000027).
7. APCI, Piping -- Oxygen Compressor Location, APCI Design Engineering Standard 570.6, January 15, 1971 (Doc. #99000029).
8. APCI, Plant Components - Air Separation, Oxygen Compressor, APCI Safety Standard 607.1.2.3, December 1962 (Doc. #99000044).
9. Lapin, A., "Testing of Screens to be Used in Oxygen Compressor Suction," APCI Memo dated July 26, 1971 (Doc. #99000291).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

3. Equipment Malfunctions and Failures

a. Equipment

(1) Gas Pressure Regulators

1. The following applies to pressure regulators manufactured by APCI and used by its customers.

a. General gaseous oxygen high pressure cylinder and low pressure line station service.

(1) Company Practices

(a) To provide detailed operating instructions to users including the recommendation that the instructions issued by makers of equipment used in combination with APCI regulators be consulted before operating the units in combination.

(b) To provide qualified factory and distributor repair service.

(c) To provide precleaned spare parts kits in sealed, dust-tight containers.

(d) To package regulators prior to shipment in tight closing protective containers and seal body openings to prevent foreign material from entering the interior of the regulators.

(e) To functionally test every regulator for safety and performance prior to final packaging.

(f) To provide regulator assemblers with proper tools and supervision to prevent defects being introduced at this point.

(g) To promote cleanliness throughout the regulator assembly operation, including an initial degreasing step of parts wetted by the gas.

(h) To provide up-to-date design documentation to assemblers to insure the use of proper parts and supplies.

- (j) To maintain a high level of quality control of regulator parts through 100% inspection of all significant dimensions and properties prior to their entry into assembly stock.
 - (k) To thoroughly degrease and deburr all machined parts prior to inspection and stocking.
 - (l) To provide maximum cleanliness and physical control in the assembly stockroom.
 - (m) To clearly identify all parts and materials in the stockroom.
 - (n) To maintain an ongoing program of product evaluation for safety and performance.
 - (o) To thoroughly investigate all reported malfunctions and failures and to take any corrective action indicated to prevent reoccurrences.
 - (p) To thoroughly test all new products under controlled conditions simulating those of actual use.
 - (q) To corroborate design safety of new products through tests by independent agencies such as Underwriters' Laboratories, Inc. Along with initial testing, UL provides a valuable ongoing implant quality audit service.
 - (r) To provide and maintain accurate, clear, and up-to-date engineering drawings and specifications and a system for effectively communicating changes to those who will execute them.
 - (s) To use all available technical information in the selection of the materials of construction and the specific design features of regulators and to keep abreast of new technology which can be applied to improving the inherent safety of regulators.
- b. Gaseous oxygen high pressure cylinder and low pressure line station service with oxy-fuel welding, cutting and heating equipment.
- (1) Company Practices
 - (a) All of a (1)
 - (b) To provide specific instructions pertaining to this service warning of the special precautions necessary to insure safety of operation

December 10, 1971

IIF3a-1 (Continued)

c. Discussion:

It is the intent of these practices to prevent equipment malfunction and failures due to:

- (1) Improper design
- (2) Faulty manufacturing practices
- (3) Inadequate cleanliness
- (4) Improper use
- (5) Improper maintenance and repair

Adherence to these practices is the responsibility of the Gas Equipment Department of APCI. Their efforts are audited by the APCI Corporate Safety Department.

d. Related APCI documents

- (1) APCI, Product Test Procedures 1200 Series Regulators, APCI January 30, 1970 (Doc. #99000287).
- (2) APCI, Operating and Safety Instructions for Regulators and Compressed Gases, APCI, Welding Products Division, WPD4-70 (Doc. #99000288).
- (3) APCI, Set Up and Operating Instructions for Air Products Redi-Set^R Welding and Cutting Outfits, APCI Form 3424 WPD 003-M-406000 (5M 92569) Rev 3 (Doc. #99000289).
- (4) Kokinda, J. J., 1200 Series Regulator -- Materials of Construction - #231-G-120054 (oxygen), Drawing #000-0-4070004E, APCI, October 25, 1971 (Doc. #99000290).
- (5) APCI, Master Drawing 1200 Series Regulations, APCI Drawing 000-0-407004E, March 4, 1968 (Doc. #99000308).
- (6) Compressed Gas Association, Safe Handling of Compressed Gases, CGA Pamphlet P-1, 1965 (Doc. #99000271).
- (7) American Welding Society, Safety in Welding and Cutting, USAS Z49.1, 1967 (Doc. #99000272).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

3. Malfunctions and failures

a. Equipment

(3) Valves

- x. Avoidance of galling - Bronze or monel globe valves with bronze or monel trim should be used for throttling or bypassing oxygen control valves regulators. When the size of the valve is such that a stainless steel body is the only practical valve available commercially the trim should be bronze or monel. If a Colmonoy 6 hard faced stainless steel seat and disc are used, the disc lock-nut must be bronze or monel to avoid any galling between a stainless steel stem and disc. Galling occurs readily with stainless steel in dry gas systems.
- y. Check valves in O₂ service should be monel or bronze. Wafer swing type with Kel-F disc inserts do an adequate job when used with centrifugal compressors. For reciprocating compressors, a swing check design is inadequate and would break down in a very short time. A reciprocating compressor plate type check valve or valve specifically designed for reciprocating service must be used.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

3. Malfunctions and Failures

- b. Geisering, Excessive Vibrations, Shock (Thermal and Pressure), Line Surges.

The Bibliography (p. 86) of the APCI Report, An Analysis of Water Hammer in Cryogenic Transfer Lines, The Mississippi Test Facility of the George C. Marshall Space Flight Center, National Aeronautics and Space Administration; APCI, February 28, 1964 (Doc. #99000358), lists several publications and articles covering the subject matter.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

F. Oxygen Transfer

3. Malfunction and failures

c. Insulation system deterioration due to vibrations

Oxygen piping is insulated with cellular glass and urethane insulation. Cellular glass insulation is used to insulate all flanges, valves, pumps, etc. where oxygen process leakage may occur in normal operations. This insulation is used for a minimum horizontal distance of 4 feet and minimum vertical distance of 10 feet on either side of the preceding locations. Urethane insulation is used on the remainder of the piping.

Cellular glass insulation is a friable material and subject to failure by vibration. The interior or bore of the inner layer of insulation is coated with a vinyl base compound to reduce abrasion from vibration and temperature change of piping.

Excessive piping vibrations, however, would be detrimental not only to the insulation system but to other mechanical devices and should be eliminated.

Urethane insulation is not friable and no special vibration cushion is used.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

II. Operational Hazards

G. Fires and Explosions

1. Methods to contain or restrict combustible mixtures.

The application of a safety factor in the design of oxygen process, storage, and handling systems for the temperature and pressure of service, provides a measure of containment for only minor reactions which occur from ignition of combustible mixtures. Containment of catastrophic high energy reactions is not considered in design for practical and economic reasons.

The intent of process design is to restrict, where possible, the entrance of combustible mixtures in oxygen process, storage, and handling systems. The methods through which this can be accomplished are (a) mechanical devices, (b) instrumentation, and (c) operating procedure.

a. Mechanical Devices - Mechanical devices are additions to oxygen systems which provide a measure of protection to restrict combustible mixtures. They may be part of the process design, requirements of codes, requirements of industry practices, or a completely separate auxiliary component for a specific function. These mechanical devices may be manually or automatically operated.

- (1) Industry developed standards, although not mandatory, requiring different valve outlet connections on cylinder valves for the different compressed gases contained in cylinders. Corresponding fittings of fill lines and various accessories are in agreement with the cylinder valve outlet connections. The purpose of this standard is to prevent the accidental filling of cylinders with the wrong and possibly hazardous product. Industry practice is published in Pamphlet V-1, Compressed Gas Cylinder Valve Outlet Inlet Connections by Compressed Gas Association, Inc.⁽¹⁾ and contains the American Standards B57.1-1965⁽²⁾ and the Canadian Standard B96-1965⁽³⁾.

- (2) Exhibit "A" of Plant Operations Manual, Section 2.02⁽⁴⁾, lists the fixed ends of transfer hoses and storage tank connections to be used for the different cryogenic liquid products to prevent intermixing at filling or customer storage sites.
 - (3) Process design of oxygen producing equipment includes the use of filters, scrubbers, and driers to remove contaminants from the process stream, and the use of hydrocarbon and guard absorbers to handle contaminants which manage to slip through with the process stream. Check valves are used to prevent reverse flow of material and double block and bleed valves are used to isolate circuits where hazardous materials are associated by design with oxygen producing, handling, and storing equipment.
- b. Instrumentation - Total hydrocarbon, acetylene spot check, oxygen, nitrogen, and other analyzers are used to continuously or intermittently monitor the various process streams of plants to detect the presence of contaminant materials which might be detrimental to the safety and operation of the equipment. This instrumentation can be tied to alarm and shutdown switches to provide an automatic system for alerting personnel to an impending hazardous situation and for protecting equipment. The area and atmosphere surrounding operation equipment are checked with portable oxygen analyzers at regular intervals or as the operation demands for oxygen enrichment or oxygen deficiency to alert personnel of a potential hazard. An explosimeter is frequently used to check the presence of flammable gases, if the process involved uses these materials.
- c. Operating Procedures - Operating procedures have been developed for oxygen process, storage, and handling systems which, in addition to optimum operating efficiency, minimize or eliminate the possibility of combustible mixture formation within equipment. Some important operating procedures to achieve control of combustible mixture formation are listed below:
- (1) Safety Standard 626.4.1, Purging Methods, ⁽⁵⁾ establishes concentration limits concerning purge operations where oxygen or air may possibly be introduced in flammable gas processes or storage systems. The purge media is nitrogen.

- (2) District Operations Manual, Section 6.3, Quality Control Program,⁽⁶⁾ lists the requirements for the regular scheduled check and double check on products at a specified quality, this control program detects the presence of contaminants which may effect the safe operation or the process handling or storage system. Similar procedures have been included in the Plant Operations Manual to maintain quality of product.
- (3) Detailed procedures exist in the District Operations Manual, Section 9.1⁽⁷⁾, and the Plant Operations Manual, Section 2.02,⁽⁴⁾ for the filling of containers with gaseous and cryogenic liquid products.

2. Avoidance of chemical reactions and flashbacks.

A safety review of APCI process, storage, and handling systems is made for the purpose of determining compatibility with gaseous or liquid oxygen. The possibility of chemical reactions with oxygen are examined during the safety review.

The many different applications in which oxygen is used by other than the producer is an area where a safety review is generally not made excepting where specifically requested. This service is available to customers and when requested, considers the chemical reaction possibility.

A universal application of oxygen is in conjunction with acetylene in the welding and burning of metal processes where piped systems are used to distribute the gases to their points of use. Design of these systems is in agreement with National Fire Protection Association Code No. 51, Welding and Cutting, Oxygen-Fuel Gas Systems⁽⁸⁾. Hydraulic flash arrestors are used in the fuel system to prevent flame from getting back to the supply source. Check valves are used at the individual use points to prevent the intermixing of gases and the formation of flammable mixtures within the system.

3. Avoidance of shock Sensitive Materials.

Materials used in oxygen process, storage, and handling systems must meet the requirements as listed in Safety Standard 609.1, Compatible Materials⁽⁹⁾ and must be suitable for the temperature and pressure of the service as specified by applicable professional and industrial codes.

4. Methods to reduce the vulnerability towards internal and external fires.
 - a. Quantity-distance requirements of the National Fire Protection Association Code No. 566, Bulk Oxygen Systems at Consumer Sites⁽¹⁰⁾ and NFPA No. 50⁽¹¹⁾ are used for both gaseous and liquid oxygen storage on customer property.
 - b. The same rules (NFPA No. 566) apply at producing facilities with possible expansion of distances between oxygen compressors and other equipment.
 - c. In the case of oxygen compressors, inventory dump accessories are provided along with appropriate instrumentation and shut-down devices to vent the oxygen, close the inlet valve, introduce nitrogen into the compressor and piping, and stop the compressor.
 - d. An oxygen compressor is always started on nitrogen and the system completely checked prior to introduction of oxygen to the system.
 - e. Plant liquid, when product quality or other reasons dictate, is drained and disposed in a location away from main plant components through a vaporizer.
 - f. Trailer vents are connected to a vapor disposal system which exhausts the vapors in an area away from plant components or where personnel may be working.
5. Protection provided for adjacent components from internal or external fires.
 - a. Personnel protective shields as per Design Engineering Standard 546.1^(12A) used around oxygen compressors have a secondary purpose of offering protection to adjacent components.
 - b. The above practice is being extended to cover protective shields around plant mounted centrifugal liquid oxygen pumps.
 - c. The oxygen compressor control panel position must be in agreement with Design Engineering Standard 546.1⁽¹²⁾ requirements and must have a protective roof as per Design Engineering Standard 534.1⁽¹³⁾.

- d. Operating plant liquid oxygen transfer from storage to rail or highway tanker loading areas are provided with a manually operated water deluge system for fire protection and vaporization of liquid spills.
- e. Fire fighting capabilities are provided at strategic locations throughout producing facilities. Fire hydrants, hose houses, hose reels, and fire extinguishers, as specified in Safety Standards 630.2.2⁽¹⁴⁾, 630.2.3⁽¹⁵⁾, 630.2.6⁽¹⁶⁾, and 630.2.2⁽¹⁷⁾.

References

- (1) Compressed Gas Association, Compressed Gas Cylinders Valve Outlet and Inlet Connections -- CGA Pamphlet V-1, 1965, (Doc. #99000235).
- (2) American Standard, Compressed Gas Cylinder Valve Outlet and Inlet Connections, American Standards Association, B57.1-1965, (Doc. #99000236), published as CGA Pamphlet V-1, 1965 (Doc. #199000235).
- (3) Canadian Standard, Compressed Gas Cylinder Valve Outlet and Inlet Connections, Canadian Standards Association, CSA B96-1965, (Doc. #99000237), published as CGA pamphlet V-1, 1965, (Doc. #199000235).
- (4) APCI, Filling Procedure for Transportable Cryogenic Containers (250 - Gallon Capacity or Larger) -- General -- APCI Plant Operations Manual, Section 2.02, August 29, 1969, (Doc. #99000238). (Same as D.O.M. Sect. 9.1).
- (5) APCI, Purging Methods -- APCI Safety Standards 626.4.1, January 1970 (Doc. #99000240).
- (6) APCI, Quality Control Program -- APCI District Operations Manual, Section 6.3, April 1968, (Doc. #99000223).
- (7) APCI, Filling Procedure for Transportable Cryogenic Containers (250 - Gallon Capacity or Larger) -- General -- APCI District Operations Manual, Sect. 9.1, April 1966, (Doc. #99000239). (Same as D.O.M. Sect. 2.02).

- (8) National Fire Protection Association, Standard for the Installation and Operation of Oxygen-fuel Gas Systems for Welding and Cutting, NFPA No. 51, 1969, (Doc. #99000242).
- (9) APCI, Oxygen Compatible Materials -- APCI Safety Standards, 609.1, June 1964, (Doc. #99000051).
- (10) National Fire Protection Association, Installation of Bulk Oxygen Systems at Consumer Sites, NFPA No. 566, 1965, (Doc. #99000190).
- (11) National Fire Protection Association, Installation of Bulk Oxygen Systems at Consumer Sites, Proposed Amendments Part II to NFPA No. 566, Passed May 1971, to be designated as NFPA No. 50, (Doc. #99000191).
- (12) APCI, Personnel Protective Shields, Oxygen Systems -- APCI Design Engineering Standards 546.1, January 15, 1971, (Doc. #99000025).
- (12A) APCI, Personnel Protective Shields, Oxygen Systems -- APCI TB-42, Applicable to APCI Design Engineering Standard 546.1, September 30, 1971, (Doc. #99000328).
- (13) APCI, Oxygen Control Panel -- APCI Design Engineering Standard 534.1, (to be published)(Doc. #99000243).
- (14) APCI, Fire Protection Equipment, Outside Fire Hydrant, APCI Safety Standards 630.2.2, July 26, 1961, (Doc. #99000244).
- (15) APCI, Fire Protection Equipment, Outside Hydrant House and Equipment, APCI Safety Standards 630.2.3, June 15, 1960, (Doc. #99000245).
- (16) APCI, Fire Protection Equipment, Deluge Systems LOX Loading Facility, APCI Safety Standards 630.2.6, January 1964, (Doc. #99000055).
- (17) APCI, Fire Protection Equipment, Inside - Outside, APCI Safety Standards 630.3.2, May 1968, (Doc. #99000246).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

III. Maintenance Program

A. System Check and Inspection Where, Why, and How

1. Structure

Structural inspection is made on a yearly, monthly, or daily task depending on the equipment and location.

Listed below are a few examples as used in the Operations Department.

- a. Inspect general condition of piping system. This should include pipe supports for overloading, deflection and cracked welds. The piping is checked for excessive stress or sagging. This is done on a daily task and is a visual inspection.
- b. Inspect general condition of enclosures of pumps and cold piping. This is generally considered as cold boxes and cold piping duct work. Over pressure protection devices are provided on these systems. The number and kind of devices and set pressure are based on the configuration, pressure rating, purge pressure, and the type insulation used in the box.
- c. Inspect general condition of Lox Storage Tanks. This inspection is depended on the type of tank. The normal structural inspection will include foundations, supports, insulation level, vacuum readings, and general condition.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

III. Maintenance Program

A. System Check & Inspection Where, Why, & How

2. Leaks

Major liquid and cold gas leaks are repaired immediately because of possible foundation heaving, over pressuring of jacket, or cracking of carbon steel structural members. First indications of leaks are frost spots and changes in purge pressure or cold vapors. A detailed procedure is attached from the APCI Plant Operations Manual section 1.14, Cold Box Leaks, Nov. 10, 1968 (Doc. #99000227). Should the leak occur in a coded vessel APCI Plant Operations Manual Section 6.09, Coded Vessels Repair, November 29, 1968 (Doc. #99000228) must be used. Quality Control Layout Pneumatic Testing QCL105A, July 1, 1971 (Doc. #99000207), and Quality Control Layout, Hydrostatic Testing, QCL117A, July 1, 1971 (Doc. #99000206) are used for testing after the repairs are made.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

III. Maintenance Program

A. System Check & Inspection Where, Why, & How

3. System Instrumentation and Controls

System instrument and control checks in operations are continuous as readings are taken on hourly basis and a malfunction of most of them will give an alarm and/or shutdown of related equipment. The Plant Operations Manual Section 6.05, Instrumentation Preventive Maintenance, October 30, 1968 (Doc. #99000229) gives inspection procedures and frequencies. The safety relief valves and rupture discs are inspected as per Plant Operations Manual section 6.02, Safety Valves and Rupture Discs, December 8, 1969 (Doc. #99000230).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

III. Maintenance Program

A. System Check & Inspection Where, Why, & How

4. Insulation

Insulation check and inspection is accomplished on a daily visual inspection and in more detail when the preventive maintenance manual requires it.

Insulation of interconnecting lines which contain low temperature streams require insulation to prevent heat input to the stream and to provide personnel protection from cold temperatures.

Insulation for liquid oxygen lines or other lines which may come in contact with liquid oxygen are non combustible to protect against the possibility of a reaction in the event of a liquid leak.

Process lines operating at temperatures colder than the condensing temperature of air are insulated with material compatible with oxygen.

Appropriate weather protection that was applied to the insulation must be maintained.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

III. Maintenance Program

A. System Check and Inspection; where, why, and how

5. General Considerations of the "aging" system

Inspection of Bulk Oxygen Storage Systems. IGD inspection procedures for gaseous and liquid oxygen storage systems at consumer sites are contained in District Operations Manual Volume 1, Section 4.2.3, and Section 4.1.3, respectively.

- a. APCI, Maintenance and Inspection Requirements for Customer Bulk Gas Supply System, APCI District Operations Manual, Vol. 1, Section 4.1.3, June 1971 (Doc. #99000192).
- b. APCI, Maintenance and Inspection Requirements for Bulk Liquid Customer Installations, APCI District Operations Manual, Vol. 1, Section 4.2.3, May 1969, (Doc. #99000193).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

III. Maintenance Program

A. System Check & Inspection, Where, Why & How

5. Preventive Maintenance Program

All of operations facilities are on a formal P.M. Program. Manuals are issued listing all tasks with a definitive numbering system for each of the tasks. Work required on a monthly or less frequent basis is on an IBM Card and the cards are distributed each month at which time the task is to be performed. The Operations Dept. Preventive Maintenance Report, Feedback Card (Doc. #99000231) is filled in if and when the work is done and returned to the corporate offices. Each month a report is issued indicating compliance in percent of "Normal" tasks and "Downtime" tasks. Man hours expended in each category are also noted. In the event downtime tasks cannot be done due to operating requirements, they can be rescheduled and they are not penalized in the compliance report. Further details are given in the "Plant Preventive Maintenance Control" Document, June 1971 (Doc. #99000232). Also attached are a few representative pages of the PM Manual.

The following lists are representative of maintenance program entries on oxygen equipment or related items. Frequencies of the maintenance tasks are also noted with one period in some cases and with a range of period intervals in others. It must be understood that the frequency is a function of not only the type of the equipment in this category but also its history, process, usage, vendor and construction which may dictate more or less frequent task requirements.

Oxygen Gas Storage

- | | |
|---|---------|
| 1. Inspect valves and packing for leaks | Weekly |
| 2. Inspect general condition of vessels, supports and piping for paint requirements. | 1 Year |
| 3. Check exterior of storage vessels, vessel supports and safety valve equipment. Check shut off valve. | 1 Year |
| 4. Soap test storage bank piping at maximum working pressures. | 3 Years |

Lox Storage and Piping

1. Check valve packings for leaks. Inspect boots on extended stem valves. Daily-Weekly
2. Inspect relief valve for leakage. Daily
3. Inspect interconnecting piping and insulation. Weekly
4. Inspect storage tank and crossover for frost spots. Weekly
5. Check crossover for oxygen concentration Weekly
6. Inspect top of tank and jacket vents. Weekly
7. Check and top-off insulation level. 1 year
8. Check to ensure controller for foundation heating is maintaining its set point. Recalibrate according to manufacturers instructions. 6 mos.
9. Check vacuum reading and record 1 year
10. Check purity from top of Lox Storage Tank. weekly

Lox Pumps

1. Defrost pump. Clean and inspect pump suction screens. Clean or replace as necessary. 3 mos.-1 yr.
2. Inspect for pump seal (or packing) leakage. Listen for any unusual noises or vibration. General visual inspection of pumps and motors. Check nitrogen purge flow. Shift-Daily
Daily.
3. Check oxygen concentration in box. Weekly
4. Check pump box for frost spots and general condition. Weekly-Monthly
5. Inspect condition of blowout panels on box. Weekly-6 mos.
6. Lox Pump (BJ)-Perform solvent wash. Prior to and after solvent wash inspect internal parts with a black light and report observations. 3 yr.
7. Lox Pump (External, usually transfer pump)-After 500 operating hours overhaul pump replacing bearings as well as other worn parts. 6 mos.
8. Lox Pump (BJ)-Perform thorough check of entire pump assembly. Replace parts as necessary. Change gear case oil. Perform wash out. 12-36 mos.

9. Lox Pump (BJ)-Rotate shaft by hand one full turn before and after cooldown. Start up

10. Inspect general condition of pump and piping system for product or oil leaks. Daily

Vaporizers

1. Check steam regulator valve. Check condensate trap. 3 mos.

2. Inspect all steam piping valves and fittings for leaks. Repair as necessary. Inspect steam drain lines and traps for plugging. Clean as necessary. Daily-weekly

3. Inspect vaporizer for cracks and general condition. Repair as necessary Daily

4. Pressure test product oxygen coil monthly

5. Shift test shell vent for high oxygen. Report and readings greater than 21% oxygen. monthly

6. Drain water side. Flush out and refill. 6 mos.

7. Wash vaporizer internally. Use methylene chloride. 4 years

8. During freezing weather check water bath temperature, heater on at 35°F and off at 40°F. Check panel heater operation. Daily

9. Thermal Research Vaporizer checks.

a. test flame guard system. Daily

b. test run burner. Allow system temperatures to reach normal operating levels. "

c. Check flame stability through sight port. Adjust as necessary. "

d. Visually inspect for leaks and sign of overheating "

e. Check combustion air blower and circulating water pump for unusual noise or vibration. "

f. Record one complete set of log readings (reconsider schedule after 3 months) "

- g. Inspect flame scanner lenses for cracks and dirt. Clean or replace as necessary. Inspect spark plug gap setting. Inspect blower discharge sleeve. Perform daily system test after performing the above work. Check for corrosion and requirements for touch-up painting. Monthly-6 mos.
- h. Replace scanner cell. Clean gas filters on combustion and oxygen analyzer. Inspect combustion blower. Clean as necessary. 1 year
- i. Clean water circulating pump suction strainer. monthly
- j. Remove and disassemble burner. Inspect for damage to ceramics and combustion chamber. Split burner at flange just below spark plug and thoroughly inspect ceramics for deposits, cracks and spalling or other damage. Replace scanner cell. 24 mos.
- k. Check tubes, tube supports, baffles and interior of shell for corrosion. Make inspection with burner removed and by removing bottom manhole and section of stock. 24 mos.

Loading Stations

- 1. Trailer and railroad loading station lot filters. Inspect and service as necessary. 6 mos.
- 2. Inspect all loading connections and hoses for wear or abuse. Replace faulty connections or hoses. Daily

Cylinder Filling

- 1. Inspect all copper pigtailed for wear and replace as necessary. Monthly
- 2. Anneal all copper pigtailed 6 mos.
- 3. Inspect tube trailer stanchion hoses, tubing and fittings for leaks, damage and proper anchorage. Repair or replace as necessary. 6 mos.
- 4. Calibrate all cylinder manifold pressure gauges. 3 mos.
- 5. Check and calibrate pressure switches. 1 year

General

1. Perform visual inspections of all safety valves. Leakers, no seal, illegible or missing date tags, signs of corrosion, etc. will require retest, repair, or replacement as necessary. 1 year

Further Details are given in the Following:

- a. Plant Preventive Maintenance Control, June 1971 (Doc. #99000232)
- b. Monthly Plant Safety Survey, Form 2032, Sect. 5.18 (Doc. #99000233)
- c. Kitson, F. K., Approved Alloy Steels in Cryogenic Service, Safety Gram No. 10, Rev. 1, October 25, 1963 (Doc. #99000040).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

III. Maintenance Program

B. Safe Cleaning Procedures for Filters, Traps, and Instruments

Filters

The only standard locations for any numbers of filters or strainers in oxygen service are the suction lines to pumps, suction lines to compressors, discharge lines of high-pressure reciprocating pumps, and in-line product filters for government requirements.

When we were using pumps in plant processes for pumping through heat exchangers to vaporize against incoming air we had suction filters on the suction lines to prevent larger particles of desiccants, solder and any other foreign material from entering the pump. There are a few of these systems still in operation but concept has changed, and we generally do not utilize this process anymore (liquid vaporization from storage, or oxygen gas compressors have succeeded this method). Generally construction was per our print 58521C(1) which has related prints specifying 10 mesh monel wire cloth, which is backed by 304 stainless steel perforated sheets (cylindrical).

We now have screens in all our transfer pumps suction lines. They have 100 mesh stainless steel conical screens. This action was prompted by fires in pumps in Airco at Bethlehem where it was believed foreign material caused the incidents.

Our old high pressure reciprocating pumps, which have graphite packing, have sintered bronze (porex) filters on the discharge side of the pump to prevent graphite and asbestos particles from getting into the exchangers and subsequently into cylinders or other area where it would be undesirable.

Government specifications for LOX require filtration of our product. Where necessary, we install in-line filters on our product hoses used to load trailers for government locations. We are presently using a Pall Trinty Rigimesh (stainless) 10 micron, 98 percent removal, 40 micron absolute removal filter assembly.

All of the above filters are cleaned in methylene chloride or trichlorethylene and blown dry with nitrogen. Air known to be dry and oil free is also permitted for drying.

Traps

I do not know of any so-called traps used in any of our oxygen systems excepting the suction line of the old APCI high-pressure reciprocating pump. At one time we had used brass refrigeration filters here, but later put a U-type "plumbers" trap made from copper return bends or street elbows just upstream of the pump. It was intended only to hold any heavy material, such as solder, in this low point and prevent the foreign material from getting into the pump or the pump valves.

This trap was cleaned initially as part of the original piping and had no further cleaning requirements.

Instruments

Instruments are generally cleaned according to our QCL 116F⁽²⁾. Design Engineering Standard 531.2⁽³⁾ specified gauges be cleaned to 116F. It also states a decal "Oxygen - Use No Oil" be affixed to the gauge.

The only other formal cleaning procedure for instruments that I could find in manuals and inquiries in the Engineering Department was QCL 102F⁽⁴⁾, Cleaning Bourdon Tube Type Gages for Oxygen Service.

References

- (1) Oxygen Pump Filter Assembly, APCI Drawing #58521C, Rev. B, December 18, 1957 (Doc. #99000234).
- (2) APCI Requirements for Class AA Cleaning -- APCI Quality Control Layout No. QCL 116F, July 1, 1971 (Doc. #99000085).
- (3) APCI Instrumentation Pressure Indicators -- APCI Design Engineering Standards 531.2, October 1963 (Doc. #99000022).
- (4) APCI Cleaning Requirements for Bourdon Tube Type Gages Used For Oxygen Service -- APCI Quality Control Layout No. QCL 102F, July 1, 1971 (Doc. #99000078).



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III. Maintenance Program

C. Pressure Testing

The following steps are followed in pressure testing

1. Secure a safety work permit
2. Areas where testing is taking place is to be considered off-limits for personnel except for authorized people doing the work. Rope off the area and display applicable signs.
3. Whenever possible, hydrostatic testing is to be utilized in preference to pneumatic testing.
4. Never test a circuit without a proper relieving device, such as a relief valve or rupture disc, as an integral part of the circuit or vessel.
5. Always use a regulator when pressurizing circuits with high-pressure cylinders.
6. Always use dry and oil-free fittings and lines when pressurizing oxygen circuits. Also, the pressurizing medium, nitrogen or air, must be dry and oil free.
7. Build up pressure gradually to 50 percent of test pressure and then in increments of 10 percent until test pressure is reached. This is especially important on high-pressure circuits. Hold a proof pressure for at least five minutes and then reduce 10 percent before "moving in" for soaping and visual inspection.
8. Stand clear of equipment while it is being pressurized.
9. Never stand in line with pipe corps, plugs, or blinds which can blow loose under pressure.
10. Before pressurizing circuits, be sure all valves are set properly and know where vent valves are located in the event that quick venting of pressure is necessary.
11. The pressure gauge must be visible to the operator when pressurizing a vessel or circuit. In cases where the operator cannot see a gauge, a second person observing the gauge must relay signals to the operator.

12. After pressurizing a circuit, wait several minutes before attempting to check lines or soap test. Remember, some flux can hold high pressure temporarily.
13. Be careful when venting and relieving pressures. Be sure all personnel are clear. Anchor all lines to prevent "whipping". When possible, vent upward rather than at lower levels.
14. If a circuit is left pressurized, warn all personnel at charge of shifts and leave signs reading "Danger - Under Pressure" in conspicuous places. Hourly checks are to be made by qualified persons to check the equipment and guard against over-pressure due to temperature.
15. Never walk away from an unfinished solder joint, threaded joint, etc. because of a rest break or shift change. Always finish the joint.
16. Be sure fittings, valves, and piping for the hookup are suitable for pressures involved.

Other Sources of Information

1. POM 1.03, Safety Control Procedure - TagOut, and POM 1.04, Safety Control Procedure - Safety Work Permit has some relationship with pressure testing as they are procedures to prevent inadvertent pressurizing of vessels or circuits not intended to be part of the test. Also, tagging of the valves serve as warnings to those individuals not part of the actual work. See attachments. These POM procedures are the same as Safety Standards 626.3.3 and 625.3.5.
2. POM procedure 6.09, Coded Vessel Repairs, outlines Operations Department action on coded vessels including pressure test. QCL 117A, Hydrostatic Testing - General and QCL 105A, Pneumatic Testing - General, are attachments to this POM procedure which are Manufacturing Department procedures used in conjunction with our work.

APCI References:

1. APCI Safety Control Procedure - Tagout, APCI Plant Operations Manual Section 1.03, February 15, 1967 (Doc. #99000202).
2. APCI, Safety Control Procedure - Safety Work Permit, APCI Plant Operations Manual Section 1.04, February 16, 1967 (Doc. #99000203).

3. APCI, Coded Vessel Repairs, APCI Plant Operations Manual Section 6.09, November 29, 1968 (Doc. #99000204).
4. Maryland Casualty Company, APCI Field Inspection Contract with Maryland Casualty Company, APCI Plant Operations Manual Section 6.09, Attachment 1, August 27, 1969 (Doc. #99000205).
5. APCI, Hydrostatic Testing - General, APCI Quality Control Standards QCL 117A, October 20, 1958 (Doc. #99000206).
6. APCI, Pneumatic Testing - General, APCI Quality Control Layout QCL105A, July 1, 1971 (Doc. #99000207).
7. Smith, H. W., APCI Safety Control Procedures -- Tag Out Procedures, APCI Safety Standards 626.3.3, May 1962 (Doc. #99000208).
8. Smith, H. W., APCI Safety Control Procedures -- Air Separation Plant Safety Work Permits, APCI Safety Standard 626.3.5, June 19, 1961 (Doc. #99000209).

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IV. System Emergencies

APCI Safety Standard 626.3.8, Emergency Procedures, May 1962 (Doc. #99000053), is the guideline for establishing specific emergency procedures for each company location considering the function of the facility and the number of people employed. The emergency conditions considered are equipment malfunction or failure, human failure, extreme climatic conditions, or national emergency.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

IV. System Emergencies

A. Safety Training and Area Placarding

1. Safety Training

a. Safety Meetings

Safety Standard 625.0.1⁽¹⁾ (duplicated as POM 5.16⁽²⁾) requires at least one safety meeting each month. This is generally complied with and all personnel are covered by the most practical scheduling. Reports on the meetings are submitted to the Operations Safety-Service Manager where they are reviewed and recorded for compliance. Non-compliance is questioned and reported to Operations management as necessary.

Generally, plant management is spokesman at the meetings. Experts from the corporate offices may hold the meetings occasionally on subjects in which they are more proficient. Also, technicians (mechanical or electrical, etc.) assigned to a range of plants may speak on safety problems in their particular fields and theories of same so a better understanding of the equipment and operating principles may prevent accidents.

Topics can be a wide range of general industrial, personnel protective, equipment or process divisions. The facilities' current problems would be given priority. Second priority would be recent problems at other plants which may be directly related to the facilities' operations. Plant managers are kept posted on these problems in order to insure distribution of pertinent information. If very important, this is done immediately by telephone. Other means of relaying the information are by memos, Safety-Grams or Safety Bulletins.

Plant incidents ranging from near accidents to accidents and their investigations are reported on standard forms. Monthly reports on injuries are reported to the Safety Department. Serious incidents are covered immediately by phone. Details for this reporting are in Corporate Administrative Procedure 1.5⁽³⁾, Safety Standard 625.0.1⁽¹⁾ and Plant Operations Manual 5.16⁽²⁾, 5.18⁽⁴⁾, and 5.21⁽⁵⁾. These procedures and associated reports are used to obtain and relay information to applicable locations.

Quality control topics are also used occasionally as safety meeting material. There is some relationship with oxygen and other gases production as the mixing with other gases, lack of sufficient purity, and end uses could result in reactions hazardous to personnel and property. Low oxygen purity or inadvertent filling of oxygen containers with another gas could directly result in loss of life; for instance, in hospital breathing usage.

b. Printed Material

Facilities are provided with periodicals and safety papers as applicable to their operations. All facilities subscribe to National Safety Council material. Technical papers are purchased and distributed.

At one time the American Institute of Chemical Engineers annual symposium report on Safety In Air and Ammonia Plants was distributed to all facilities. However, the last four (there are twelve volumes) were essentially all limited to the ammonia plant and distribution was limited to New Orleans and a few key personnel in the Operations offices.

All facilities have copies of the Plant Operations Manual, one section of which is devoted entirely to safety. Operators have their own copy of this POM in the control room with the Safety, Quality Control, and Operations sections for their review and reference. Many times the new or revised procedures are covered formally in safety meetings.

Each facility also has two binders, one specifically for the AIChE symposium reports and another for all Safety-Grams and Safety Bulletins issued by the Safety Department. The Safety Manual also contains copies of miscellaneous technical papers applicable to our work.

For the last ten years all employees have been issued a pocket size Operations Safety Manual for ready reference. It includes the following sections:

- Safety Organizations
- General Safety Rules
- Properties of Products
- Safe Handling of Cryogenic Liquids
- Safe Handling of Compressed Gases
- Plant Operation and Maintenance Safety
- Maintenance and Shop Procedures
- Plant Housekeeping
- Protective Clothing and Equipment
- Chemicals
- First Aid Instructions
- Fire Protection
- Office Safety

This pocket manual has been revised several times and reprinted. However, this past year it was decided to discontinue its use when the present supply is exhausted. Company growth, expanded operations, diversified products, etc. now make it impractical to include even the main items as revisions and additions are needed constantly. The POM does this job better and since it is available in all control rooms and is a looseleaf manual, it fills the bill adequately.

2. Area Placarding

Main placarding at air separation facilities are the No Smoking signs. Generally, there is no smoking permitted except in offices, control rooms and locker rooms, but areas of increased hazards may have additional reminders.

Other placards used as applicable are listed below:

- a. Fire Extinguishers - May have bright red paint at the actual hanging area to facilitate location in emergencies and also act as an indicator to the fact that one belongs at that location so replacement can be expedited if necessary.
- b. "Authorized Personnel Only" - Generally used in electrical bays only and in the immediate areas of oxygen compressors. Oxygen compressor areas are so posted to reduce personnel exposure to fire possibilities. Also, authorized personnel are familiar with the compressor and must first check operating conditions to be sure they are satisfactory before they spend any appreciable amount of time in the area.
- c. "Danger, Do Not Stand in Front of Cabinet While Motor is Being Started" - These signs are posted on motor terminal boxes containing switches, lightning arrestors and capacitors rated 2500 volts or higher. There have been several incidents of explosions of this type of equipment. One man was hurt quite seriously in one case.
- d. "Danger, High Voltage" - As applicable.
- e. "Danger - No Smoking, Matches or Open Lights" - Or similar sign in storage battery areas where hydrogen may be emitted.
- f. Exits - As applicable for more remote escape routes.

- g. "Danger Caustic" and "Danger Acid" - As necessary to applicable areas for purifier or water treatment.
- h. "Caution, May be High in Oxygen" - For areas, such as in storage tank skirts where there may possibly be oxygen leaks and/or concentrations. Also, nitrogen tanks indicate there may be an asphyxiating atmosphere.

A good many other signs for normal industrial safety considerations are used, such as:

Fire Hose
Emergency Shower
Safety Glasses and Hard Hats Must be Worn
Visitor's Parking
Visitors Must Apply at Office
Chemicals Goggles Must Be Worn in This Area

3. References

- (1) APCI, Industrial Safety Policy, APCI Safety Standards 625.01, October 3, 1961, (Doc. #99000241).
- (2) APCI, Industrial Safety Policy, APCI Plant Operations Manual Section 5.16, October 30, 1968, (Doc. #99000253).
- (3) APCI, Accidents Reporting, APCI Corporate Administrative Procedure, No. 1.5, April 1, 1968, (Doc. #99000254).
- (4) APCI, Safety Reports and Forms, APCI Plant Operations Manual, Section 5.18, March 3, 1970, (Doc. #99000233).
- (5) APCI, Accident Reporting, APCI Plant Operations Manual, Section 5.21, May 8, 1968, (Doc. #99000255).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

IV. System Emergencies

B. Warning Devices

Warning devices for oxygen systems vary with process, application and vendors variations of similar equipment. However, most of the systems have some general applications. Unless otherwise noted, the summary below is for general applications.

Compressors - Oxygen

1. Process Stream

- a. Low pressure switch and alarm upstream in the suction of a centrifugal compressor to recycle the compressor if suction pressure decline continues to sub-atmosphere level. For reciprocating compressors, it will not recycle but will alarm and shut down.
- b. A low temperature switch and alarm on suction piping of any compressor taking suction from a possible cold source. Setting shall be based on area climate but in no case shall it be set below -5°F .
- c. A high temperature indicator-switch and alarm shall be provided on each stage discharge upstream of the cooler. Maximum permissible alarm and shutdown settings shall be 340°F and 350°F respectively. Each producing facility shall establish a lower setting when operating temperatures indicate this is possible. Alarm and shut down points shall then be 10°F and 20°F respectively above maximum normal summertime operating temperature.

2. Lubrication

- a. For centrifugal compressors, a high oil temperature indicator-switch, bulb type shall be installed in the oil return header from the bearings to the oil sump. The switch shall be connected to the alarm on the oxygen compressor instrument panel. The intent of this requirement is to warn the operator of excessive oil temperature due primarily to insufficient water flow.
- b. For reciprocating compressors, the high oil temperature indicator switch shall be in the oil return line from the cooler to the sump.

3. Motor

- a. The motor winding temperature indicator shall be located on the main instrument panel. A switch shall automatically shut down the compressor on excessive temperature.
- b. The motor cooling air temperature switch shall actuate an alarm located on the oxygen compressor panel in case of excessive temperature.
- c. Water-cooled motors shall be protected against internal water leakage from overhead coolers by a liquid-level switch connected to an alarm on the oxygen compressor panel or by a bottom drain continuously open to atmosphere.

4. Cooling Water

- a. A pressure switch shall be connected to actuate an alarm located on the main instrument panel, in case of abnormally low water pressure in the water pump outlet header.
- b. Loss of cooling tower fan operation shall be indicated by an alarm located on the main control panel.

5. Seal Gas System (centrifugal compressors only) - A labyrinth system with nitrogen as a sealing gas is an integral part of centrifugal compressors to prevent bearing lubricating oil from reaching oxygen systems. Generally, at least a double protection is provided by these seal systems.

- a. Pressure switches shall be provided to alarm and shut down the compressor when manufacturers' limits are exceeded for the following conditions.

Pressure at bearing end is too low
Pressure at injection part is too low
Pressure at impeller end is too high
Differential pressure between impeller and
injection part is too low

- b. Seal gas backup system pressure is too low (alarm only)

NOTE: Backup system is provided in the event primary seal source has problems. Usually, the backup source is a cylinder supply with sufficient storage to get primary system working or shut down the compressor.

6. Rotor Shift (centrifugal compressors only) - A rotor shift device is incorporated to indicate wear on the thrust shoes and if wear is excessive to shut it down. Normally, there is a bleed-through of gas in this system, but as wear on shoes progresses, it will permit it to touch the plunger which actuates a gear and permits a piston to drop. When this piston drops, it stops the bleed-through, builds pressure and actuates the alarm and shut down.

7. Vibration - Centrifugal Compressor

a. Equipment shall be provided for monitoring radial vibration, axial vibration and axial position of each compressor rotor shaft and of the high speed pinion. This equipment shall be connected to the oxygen compressor instrument panel alarm. A switch shall shut down the oxygen compressor in case of excessive vibration at any point normally connected for continuous monitoring.

b. Continuously monitored vibration points shall be set for alarm and shut down at initial startup and every major overhaul as follows:

| | | |
|--------------------------|----------|---------------------|
| Maximum Normal Vibration | +0.5 mil | Alarm |
| Maximum Normal Vibration | +1.5 mil | Automatic Shut down |

8. Vibration - Reciprocating Compressors

a. Seismic type vibration switches shall be provided to shut down the compressor when frame vibration amplitude increases to twice the value at the new conditions as accepted by Machinery Engineering. A minimum of one switch per two crank throws is required. Each switch shall be wired to light a yellow light, which will indicate the switch that has shut down the compressor. The light shall be maintained until the switch is reset.

NOTE: The majority of the above information was extracted from APCI Design Engineering Standard 570.7, APCI Operated Oxygen Compressor System, July 19, 1971 (Doc. #99000256).

Vaporizers

1. Warm discharge side of vaporizers generally go into carbon steel piping. Temperature switches are applied here to sound alarms if piping gets too cold, usually due to

insufficient heating source (water or steam). The liquid source (pump or valve from a pressurized tank) is shut off at the same time the alarm is sounded.

2. Thermal Research Type Vaporizers (Natural Gas Fuel) - Alarms and shut downs for this system are:
 - a. Low temperature switches, similar to Item 1 above.
 - b. Pressure switch to act in the event the natural gas supply pressure is low or high.
 - c. Low pressure switch for air blower.
 - d. High temperature switches for the downcomer in case of low water level.
 - e. High stack temperature switch, in case stack temperature is too high as a result of low water level.
 - f. Low water level switch.
 - g. Flow switch to act in case of failure of water pump.
 - h. CGA combustible gas analyzer to indicate incomplete combustion. Calibrated 0-2 percent total combustibles in an inert atmosphere.
 - i. Fire Eye to indicate no flame condition.

Pumps

1. Some of the older plants had low-pressure alarms on suction side of pumps to indicate loss of feed or low head to the pump. General use was on BJ type pumps.
2. New plants are now getting low current (amps) devices to indicate low suction pressure. Low pressure and low current switches are both to prevent cavitation and subsequent damage to the pumps, particularly bearings and shafts.

Product Lines

1. Some customer feed lines are provided with alarm indicating low pressure. Low pressure could be indicative of failure of some of our equipment, excess demands by the customer or

failure of the line. Excess flow valves are installed at a few older locations and most of the new plants whereby a line failure would also automatically shut off this valve. Excess flow valve is actuated by readout on a flow indicator across an orifice section. Ashland, Cleveland and Los Angeles have such systems. The Cleveland valve prevented a more serious incident some years ago when the customer had a fire in their reducing station and the excess flow valve was actuated.

Storage Tanks

1. Low pressure storage tanks have low pressure alarms, usually set at approximately 1 psig, to warn operators if there is a tendency to approach vacuum conditions which could cause a tank collapse. Buildup coil system malfunction could result in lowering of pressure, particularly during withdrawal procedures.

General

1. It is our policy to install temperature switches in an area where carbon steel lines may be cooled down to -20°F or lower due to malfunctions of equipment. This is mentioned above for lines downstream of vaporizers, but is applicable in other areas. This same arrangement has been used where expansion of gas may cause excessive cooldown, but general rule here is to use proper materials of construction rather than the switch. Switch is tied into an alarm and/or applicable systems shut down to prevent further cooling.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

IV. System Emergencies

C. Protection

1. Personnel

The adequacy of personal protective equipment is insured by testing and maintenance as required by APCI, Plant Operations Manual 1.12 (1).

a. Eye Protection

Safety glasses must be worn at all times in areas such as operating areas, cylinder filling areas, and near any grinding or cutting operations.

Glasses must be worn by office personnel or visitors when in these areas.

Working around welding operations, flash goggles with side shields must be worn.

Employees who normally wear prescription glasses may obtain safety spectacles, made according to their prescription through the company.

Face shields and chemicals goggles must be worn during mixing or transferring of corrosive materials.

Goggles must be used when using a stationary or portable grinder.

Chemical goggles must be used during any operations requiring the use of solvents or cryogenic liquids. Additional eye and face protection may be required in some locations for special reasons.

References Safety standards Sec. 627.4.2 (2), Safety-Grams No. 1 (3), 29 (4), 30 (5), and 58 (6).

b. Hard Hats

Safety hats-caps must be worn by all operating personnel around machinery, operating areas, and storage areas. The only exempted areas are the office, control rooms, and locker rooms.

Visitors, office personnel, and maintenance men are required to follow the same instructions as above.

Safety hats-caps are excellent protection against falling objects.

The wearing of hard hats is mandatory at all operating facilities.

Reference Safety Standard Sec. 627.4.1 (7).

c. Safety Shoes

Realizing the importance of safety shoes, the company contributes toward the purchase of safety shoes and recommends their use. Injury records prove the reduction in the frequency and the severity of foot injuries by personnel wearing safety shoes. Safety shoes are not mandatory, but are urged and recommended at all facilities.

Reference Safety-Gram No. 11 (8).

d. Respiratory Protection

Filter-type respirators are to be used when working in dusty areas or when handling dust-producing materials such as rockwool or perlite.

Respirators equipped with "rebreathers" in which the wearers breath is passed over alkali peroxide to replace oxygen and remove carbon dioxide, should not be used in trichlorethylene service. Reaction of trichlorethylene with the caustic formed during the regenerating reaction leads to the formation of dichloroacetylene, which is highly toxic and explosive.

Self-contained or air-line breathing apparatus is to be used in any area where there is a high concentration of solvent vapors or where the oxygen content of the atmosphere is below 18 percent. Life lines will be used except when otherwise instructed. Areas to be considered are, internal cleaning of storage tanks and vessels, and entry of cold boxes with nitrogen atmosphere when using cleaning solvents.

Reference Safety Standard Sec. 627.3 (9).

e. Hearing Protection

Operations Department has been supplying hearing protection equipment as needed or requested for a number of years. Wearing of this equipment is now mandatory largely where the occupational noise level exceeds 90 decibels as measured on the "A" scale of a standard sound level meter at slow response, regardless of octave band. Sound level surveys are made at each location and safety meetings are held with employees.

Safety meeting outlines include: Reasons for concern, sound measurement, exposure limitations, parts of the ear and their function, and where protection should be worn. Generally, ear plugs are satisfactory, but ear muffs are recommended where noise levels reach 110 decibels. There may be occasions where the decibel level may exceed 130, for these exposures both the ear plug and the ear muff shall be provided and used.

Reference Safety Standard Sec. 627.4.8 (10), Memo Operations Hearing Protection Program, H. Master, Dated 4/7/71 (11), Safety Standard Sec. 625.0.1.2 (12).

f. Gloves

Neoprene or suitable plastic gloves are to be worn during handling of solvents, acid, or other harmful chemicals.

Approved gloves with gauntlets are to be worn during cryogenic liquid transfers or handling.

Approved gloves for electrical service are supplied. These are high voltage lineman's gloves and lineman's leather protector gloves.

Gloves are also supplied for normal every day use.

g. "Check In" Systems

The Safety Department recommends the guidelines listed be utilized in establishing the controls to provide a means of checking on the conditions of personnel who are working alone, performing emergency maintenance work or daily routine operations. Obviously where a "check-in" system can be established with a near-by Air Products facility, customer personnel, or neighboring industry guard service, such an arrangement shall be made. The hazards inherent in the type of work being performed by the individual shall be the criteria used in determining whether a "check-in" system is required.

Flammables-Regularly scheduled operations with one man/shift at any facility handling flammables must be provided with a positive method of "check-in" by the operator. The frequency of "check-in" may vary with the type of system established but must provide a minimum operator "check-in" once every hour.

Oxygen - A "check-in" system for one man/shift operation is required if routine operations necessitate operation from more than grade elevation or if cryogenic liquid loading operations are performed. The frequency of "check-in" shall be a minimum of once every hour.

Maintenance - Maintenance work on systems containing flammable gases will require the presence of more than one person.

Maintenance work on energized electrical systems with voltages up to 250 volts will require the presence of more than one person. Under no circumstances are personnel permitted to work on energized circuits with voltages exceeding 250 volts. Work on de-energized circuits with voltages of 440 volts or above will require the presence of more than one person. The second person need not be an electrical technician.

Acceptable "check-in" systems - The "check-in" system utilized shall be a reliable method of determining the responsiveness of an individual.

The A.D.T. system is used at many facilities. A switch must be actuated every hour or an alarm is flashed in the A.D.T. office. They in turn call the plant and if there is no answer they will investigate or call facility management.

The telephone system, by being called or by calling another facility, or a guard service hourly..

Reference Kitson, F. K., Staffing and "Check-In" Systems for Operating Plants, June 25, 1968 (13).

h. First Aid Instructions

All injuries, no matter how slight, must be reported to facility management, and shall be treated immediately.

A first aid record must be kept of all injuries, their cause, and the first aid treatment.

First aid kits are not a substitute for dispensary or medical treatment. It is merely the first step in preventing a bad situation from becoming worse.

Know the location of stretchers, first aid kits, fire blankets, and other first aid equipment.

Know the emergency numbers or where they can be found for doctor, hospital, and ambulance service.

First aid is no substitute for proper medical attention. Injuries of any magnitude must be referred to a competent physician after first aid treatment.

Minor injuries: treat accordingly as listed under first aid guide or refer to the Red Cross First Aid Manual, which is available in all first aid cabinets. If there is any doubt to the seriousness of the injury, the patient should be driven to the doctor after first aid treatment. Make notations with full particulars on the first aid record sheet.

Serious injuries: call for a doctor and/or ambulance immediately. Be sure to keep the patient warm and lying down. Attend to serious bleeding immediately and give artificial respiration if necessary. Do not move the injured person unless absolutely necessary. Contact management as soon as practical.

i. Evacuation Routes

Management of each APCI facility prepares a plan for quickly evacuating all areas in an orderly fashion and in a minimum of time. The plan, clearly identifying all evacuation routes and exits, is posted at convenient locations in all areas.

Personnel are trained to direct an orderly evacuation and to secure their area before leaving.

The evacuation plan is reviewed and revised every six months or less if conditions arise which warrant changing the plan.

2. References

- (1) APCI, Personal Protection Equipment Maintenance, APCI Plant Operations Manual 1.12, April 21, 1967 (Doc. #99000104).
- (2) Smith, H. W., Personnel Protective Equipment, Eye Protection, APCI Safety Standards 627.4.2, October 1962, (Doc. #99000316).
- (3) APCI, Pressure Gauge Failure, Safety Glasses Save Another Pair of Eyes, APCI Safety-Gram No. 1, June 1, 1961, (Doc. #99000317).
- (4) Smith, H. W., Safety Equipment Never Prevents an Accident --- It only Prevents an Injury, APCI Safety-Gram No. 29, August 1, 1963 (Doc. #99000318).

- (5) Ball, W. L., Are Safety Glasses Worth the Cost and Effort?, APCI Safety-Gram No. 30, August 9, 1963 (Doc. #99000329).
- (6) Schmoyer, W. W., And Then There was Darkness, APCI Safety-Gram No. 58, March 15, 1967 (Doc. #99000319).
- (7) APCI, Personnel Protective Equipment, Wearing Apparel, Hard Hats, APCI Safety Standards 627.4.1, June 15, 1970 (Doc. #99000320).
- (8) APCI, Safety Shoes, APCI Safety-Gram No. 11, May 14, 1962 (Doc. #99000321).
- (9) Smith, H. W., Personnel Protective Equipment, Respiratory Protective Equipment, APCI Safety Standards 627.3, January 1964 (Doc. #99000322).
- (10) APCI, Personnel Protective Equipment, Occupational Noise Protective Equipment, APCI Safety Standards 627.4.8, September 1969 (Doc. #99000323).
- (11) Master, H. H., Operations Hearing Protection Program, April 7, 1971 (Doc. #99000324).
- (12) APCI, Industrial Safety, Occupational Noise, APCI Safety Standards 625.0.1.2, April 9, 1971, (Doc. #99000325).
- (13) Kitson, F. K., Staffing and "Check-In" Systems for Operating Plants, APCI Safety Dept. Memo, June 25, 1968 (Doc. #99000326).

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IV. Systems Emergencies

C. Protection

2. Buildings and Adjacent Systems Protection

a. Deluge Systems:

Deluge Systems are used at cryogenic liquid loading facilities where daily transfer operations are conducted on a routine basis.

A spray nozzle is provided at each liquid loading connection. The adjustment of the nozzle depends on available G.P.M. capacity and pressure of fire water system. The nozzle pattern is set for full coverage of the rear of the trailer with sufficient angle to allow for the trailer to be spotted off center from the loading connection. The system is provided with an air operated block valve which is actuated from at least two remote positions or a manual valve when the valve can be located in a safe operating area.

References: Safety Standards Sec. 630.2.6 (1)

b. Barriers:

Protective barriers of single sheet corrugated steel are erected around most stationary liquid oxygen pumps, (B.J. pumps excluded).

The protective barriers are installed in such a manner that the operator will be protected from metal parts, liquid, or a fire in the event of a pump failure and fire.

The protective barriers, for oxygen gas compression systems, vary due to the size and type of compressors, and are fully covered in the APCI Design Standards.

References: Stompler, R. D., LOX Pump Safety Barriers,
February 19, 1971 (2)
APCI Design Engineering Standards 546.1 (3)
APCI Technical Bulletin No. 42 (4)

c. Fire Protection:

The guides for fire protection are based, where possible, on National Fire Protection Association Codes, the Insurance Carrier, and The Company Standards. In all instances fire

protection at the facilities exceed the requirements of the insurance carrier.

The first consideration for a fire water system is the availability of water, its source, volume and pressure.

Hydrant locations are based on the specific exposure in the facility. Generally, they will be located at least a minimum of fifty feet from the exposure.

Each hydrant has a house and is equipped with double doors which open outwards. The standard equipment for each house includes a spanner and hydrant wrench, hose straps, hose fittings, nozzles, and hoses.

Normally the facilities have a small complement of men, with this in mind the hose equipment provided is designed for ease of handling.

The facilities are instructed to follow the rule of calling outside help first then combating the fire. If help is available naturally fire fighting equipment is put into service while one employee phones for assistance.

Portable fire extinguishers are located according to what is considered to be possible problem areas in the facility. The two types used are the Dry Powder and Carbon Dioxide extinguishers. The inspection of these are on a regular schedule by the employees with the duty rotated to keep each man acquainted with the locations.

Monthly safety meetings are conducted at each facility with each employee explaining the fire fighting equipment along with personnel safety.

References: APCI Operations Safety Manual (5)
APCI Plant Operations Manual, Section 1.13 (6)
C.G.A. Report by M. H. Hubbs, pp. 175-189,
Oct. 15 and 16, 1963 (7)
APCI Safety Standards 605.1 (8)
APCI Safety Standards 605.1.3 (9)
APCI Safety Standards 610.1.1 (10)
APCI Safety Standards 625.0.1 (11)
APCI Safety Standards 626.3.8 (12)
APCI Safety Standards 627.4.7 (13)
APCI Safety Standards 627.5.1 (14)
APCI Safety Standards 630.2.2 (15)
APCI Safety Standards 630.2.3 (16)
APCI Safety Standards 630.3.2 (17)

d. References:

- (1) Kiston, F. K., Fire Protection Equipment, Deluge System, Deluge System, LOX Loading Facility, APCI Safety Standards 630.2.6, January 1964 (Doc. #99000055).
- (2) Stompler, R. D., LOX Pump Safety Barriers, APCI Memo, February 19, 1971 (Doc. #99000327).
- (3) APCI, Personnel Protective Shields, Oxygen Systems, APCI Design Engineering Standards 546.1, January 15, 1971, (Doc. #99000025).
- (4) APCI Technical Bulletin No. 42 Applicable to Design Engineering Standards 546.1, September 30, 1971, (Doc. #99000238).
- (5) APCI, Operations Safety Manual, APCI 20P64 (Doc. #9000330).
- (6) APCI, Maintenance of Portable Fire Extinguishers, APCI Plant Operations Manual, Sect. 1.13, March 30, 1967 (Doc. #99000331).
- (7) Hubbs, M. H., Fire Protection, Air Separation Plant Safety Symposium, P. 175 to 189, CGA Meeting, Chicago, Ill., October 15 and 16, 1963 (Doc. #99000332).
- (8) Ball, W. L., APCI Plant Site Criteria, Air Separation, APCI Safety Standards 605.1, November 10, 1960 (Doc. #99000042).
- (9) Ball, W. L., Criteria, Air Separation Plants Layout, APCI, Safety Standards 605.1.3, January 6, 1961 (Doc. #99000043).
- (10) Ball, W. L., Check List, Air Separation Plant Site, APCI Safety Standards 610.1.1, November 28, 1960 (Doc. #99000052).
- (11) Ball, W. L., Industrial Safety Policy, APCI Safety Standards 625.0.1, October 3, 1961 (Doc. #99000241).
- (12) APCI, Safety Control Procedures, Emergency Procedures, APCI Safety Standards 626.3.8, May 1962 (Doc. #99000053).
- (13) APCI, Personnel Protective Equipment, Aluminized Heat Protective Clothing, APCI Safety Standards 627.4.7, May 1968 (Doc. #99000333).
- (14) APCI, Personnel Protective Equipment, Tonnage Air Separation Plant, APCI Safety Standards 627.5.1, June 14, 1970 (Doc. #99000334).

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- (15) Smith, H., Fire Protection Equipment, Outside Fire Hydrants, APCI Safety Standards 630.2.2, July 26, 1961 (Doc. #99000244).
- (16) APCI, Fire Protection Equipment, Outside Hydrant House and Equipment, APCI Safety Standards 630.2.3, June 15, 1970 (Doc. #99000245).
- (17) APCI, Fire Protection Equipment, Inside - Outside, APCI Safety Standards 630.3.2, May 1968 (Doc. #99000246).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

IV. System Emergencies

E. Hazards Protection

One of the prime considerations when locating a new facility is the immediate industry in the area. A survey is made within a substantial radius of the proposed site to eliminate trouble areas that could not be controlled. There are instances where undesirable industry has located next to one of APCI facilities and precautionary measures must be undertaken. Listed below are a few instances where this has occurred and the action taken to protect equipment and personnel.

The Delaware City facility had a chlorine plant built adjacent to it. The first thing that is normally done is to get to know the hazards involved such as possible spills, abnormal process vents and possible line ruptures. This is usually done by a meeting with the new facility management and receiving a firm agreement to be notified immediately in the event of an emergency. APCI has purchased 20 masks which is a sufficient number to protect the maximum personnel in the plant at any one time. The masks are for escape from the area and not for prolonged exposure. Self-contained breathing type masks were purchased for prolonged exposure and are used by operators to secure the facility.

All personnel are advised on the use of the masks and the hazards involved. Escape routes are posted and an alternate gate was installed for emergencies.

The procedures for emergency shutdowns are posted and take minimum time.

The escape type masks are the Willson Double-Cartridge Filter Series 800C with the #43 cartridge. These are for maintenance type personnel and are used for immediate evacuation of the area.

The prolonged exposure type masks are the 272-OVAG-L with full face as manufactured by Acme Protection Equipment Co. This type is effective for an adequate period of time to permit securing the equipment in a safe and orderly manner.

The Alcoa, Tennessee installation had a chlorine storage tank located in the immediate vicinity. The concern again was mainly to supply suitable gas masks and proper instructions to the personnel located at the facility. This installation is a one man operation. The type mask used here is the Scott Scapak, Model 9000 11-03 with an extra cylinder. This gives the man sufficient time to secure the facility in an orderly manner. The Willson

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TLGW mask with LG3 cannister case is available for maintenance personnel which could be on site, and they would be expected to evacuate immediately.

The new Martinsville, West Virginia installation had a problem with a neighboring facility venting large amounts of NO₂ gas. The neighbor at the time was having what is considered normal start-up problems and have since remedied these. The neighbor also stores phosgene gas at the facility. We have purchased sufficient number of gas masks and posted emergency procedures.

Where a facility is located in a extreme hazardous area, such as in a storage area containing flammable liquids, we would consider installing a system which would provide a curtain of water between the hazard and the facility. This is of course considered an extreme case.

The protection and precautions taken are decided upon, after the hazards from neighboring facilities are studied. The facilities are equipped with proper type portable fire extinguishers. The larger facilities have fire water loops and hose houses located strategically.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

IV. Systems Emergencies

E. Hazards Protection

The following APL bulletins and reports identify and discuss various problems related to oxygen safety:

- (1) Everson, I., Notes for Guidance of Customers Having Air Products Ltd. Oxygen Equipment, APL Safety Department Information Sheet No. 19, (Doc. #99000422).
- (2) Everson, I., Fire Hazards in Compressed Air and Oxygen Rich Environments, APL Safety Department Information Sheet No. 33, (Doc. #99000423).
- (3) Denison, D. M., An Assessment of the Fire Risks of the Oxygen Environment Experiments, RAF Institute of Aviation Medicine, Farnborough, Hants, FPRC/Memo 217, January 1965, (Doc. #99000424).
- (4) Denison, D. M., J. Ernsting, and A. W. Cresswell, The Fire Risks to Man of Oxygen Rich Gas Environments, RAF Institute of Aviation Medicine, Farnborough, Hants, FPRC/Memo 223, July 1965, (Doc. #99000425).
- (5) Denison, D. M., and W. J. Tonkins, Further Studies Upon the Human Aspects of Fire in Artificial Gas Environments, RAF Institute of Aviation Medicine, Farnborough, Hants, FPRC/1270 September 1967 (Doc. #99000426).
- (6) Everson, I., Hazard Level of Hydrocarbon Films in Oxygen Systems (Important Data Extracted from a Paper Presented by W. L. Ball (APCI) at the AIChE Annual Meeting, Air and Ammonia Plant Symposia, September 25-27, 1961), APL Safety Department Information Sheet No. 41, April 8, 1971, (Doc. #99000427).
- (7) Everson, I., Limiting Values of Oil Contamination of Stainless Steel Surface Exposed to Gaseous Oxygen, APL Safety Department Information Sheet No. 42, April 8, 1971, (Doc. #99000428).

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

V. Accident/Incident Investigation and Report

Accidents Involving Spills and Leakage

It has been Air Products' experience that accidents involving liquid oxygen tankers and oxygen tube trailers do not result normally in a loss of product. There have been occasions when the liquid oxygen tanker has been damaged to the extent that transfer from the damaged vehicle was believed to be necessary. If the product cannot be completely transferred into another tanker it is our practice to add liquid nitrogen to the "heel" of liquid oxygen remaining in the disabled vehicle to bring the residual liquid to a liquid air concentration. The remaining heel of liquid air is then discharged to a safe location.

The infrequent LOX spills which have occurred within IGD have not resulted in a serious problem. The most recent occurred on February 24, 1971, when approximately 2,500 gallons of LOX discharged from a 6,000 gallon tank. The direction of vapor drift and flow was controlled by fire hose streams to prevent the oxygen vapors from drifting toward a residential section. Water was not sprayed on the liquid oxygen.

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

V. Accident/Incident Investigations and Reports

Accidents involving oxygen equipment and systems which cause injury to personnel or damage to equipment and property are thoroughly investigated to determine the cause and the corrective action necessary to prevent recurrences.

A. Reporting Requirements

Corporate Administrative procedure requires reporting all accidents to the various managers of departments and divisions, the Corporate President, and the Safety Director. The more serious accident is initially reported by telephone and followed by the appropriate form reporting requirements. The less serious accidents are reported by submitting the forms required. Accidents involving personnel or property of third parties (customer, general public, etc.) are reported by telephone to the responsible managers including the Law Department.

Forms used to report injuries to personnel contain information as required by federal, state or local governments, workmen's compensation; and/or by the insurance carrier. Copies of typical forms are attached. Equipment damage report forms may be memoranda describing the accident or incident.

B. Investigation of Accidents

Each accident involving oxygen and/or oxygen equipment is investigated to determine cause and corrective measures necessary to eliminate or minimize the possibility of recurrence. The extent of the investigation is determined by the type equipment involved and the extent of injury to personnel. The level of investigation for an oxygen gauge failure which caused personnel injury will be greater than a gauge failure which does not involve personnel injury. On the other hand, an accident involving an oxygen compressor or an air separation plant is extensively investigated whether personnel are injured or not because of the economic and technical significance to other Company operating areas.

The investigation of accidents may be made by a competent individual or by teams of specialists, including consultants, using available techniques in determining the mechanics of reaction which caused the accident.

Accidents which occur to oxygen equipment manufactured, owned, and/or operated by other companies and industries are investigated to the extent possible on information obtained through news media, confidential correspondence, professional society symposiums, and federal agencies.

C. Records

Records are maintained on all accidents pertaining to oxygen and/or oxygen equipment which occur within our Company and users of equipment manufactured by our Company. Records of accidents occurring to other companies are also maintained.

For convenience of identification and record retrieval, categories of oxygen equipment failures have been established as follows:

1. Air Process Plants
 - a) General
 - b) Reboilers
2. Oxygen Compressors
3. Liquid Oxygen Pumps
4. Oxygen Regulators and Related Equipment (Torches)
5. Piping and Lines
6. Storage Systems
7. Gauges and Instrumentation
8. Highway and Rail Tankers

Summaries of accidents in each equipment category are maintained and periodically reviewed:

D. Summary of Accidents

The attached summaries are identified to be in agreement with the categories established in paragraph "C". The column headings on the summaries indicate the date of accident, location of accident by State or Country, equipment owned and operated either by "APCI" or "other" companies with similar activities, component and/or plant size where applicable, and a remarks column which briefly summarizes the accident. The summary applicable to oxygen regulators and related equipment pertains only to equipment manufactured by APCI.

1. Air Process Plants
 - a) General

Table VD1a lists accidents to air plants and identifies the component involved where the reaction occurred.

Analysis of each accident led to recommendations to minimize or eliminate the possibility of recurrence.

Review of the summary indicates retraining was necessary in the case of the IT/D plants. Limitations on the oxygen content of reactivation nitrogen for the 75T/D plants, plus some procedural and instrument design changes essentially eliminated air drier type of fires. Establishment of plant washout programs minimized the possibility of expansion

engine oil absorber reactions. Analyzing contaminant concentrations in process streams and establishing limits of contaminant levels has improved the operating record of air plants. Established preventive maintenance programs has further reduced the possibility of accident recurrence.

b) Reboilers

Table VD1b lists the accidents occurring to air process plant reboilers as a group. The column heading "reboiler type" is letter coded as follows:

- A. Shell and Tube (internal to column) Oxygen or crude oxygen is on the shell side and nitrogen gas is condensed in the tubes.
- B. Thermo-syphon Reboiler (external to column) Shell and Tube. Oxygen passes through the tubes from bottom to top and nitrogen is condensed on the shell side.
- C. Extended Surface (Plate and Fin) Reboilers (external to column). Oxygen passes upwards in its passages and nitrogen passes downward through its passages.
- D. Extended Surface (Plate and Fin) Reboilers (Internal to Column). Oxygen passes upwards in its passages and nitrogen passes downward through its passages.
- E. Extended Surface (Plate and Fin) Reboilers (Internal to Column). Same as "D" but crude oxygen instead of oxygen.
- F. Modified Single Column. Small packed exchangers operating at elevated pressure and attached to a low pressure single column for the purpose of condensing nitrogen reflux streams.

Early plant reboiler failures led to the development of the hydrocarbon analyzer to constantly monitor hydrocarbon in process streams. A quick spot check test for acetylene concentration in plant liquids also came into regular use. Operating changes include disposing of given amounts of plant liquids continuously or at regular intervals to remove contaminants. Some design improvements evolved as a result of reboiler failures.

2. Oxygen Compressors

Table VD2 lists oxygen compressor reactions which have occurred in recent years. A series of reactions have occurred during World War II with water lubricated oxygen compressors and driers due to incompatibility of materials used.

To minimize the damage from reaction, inlet suction screens, vibration detectors, temperature sensors, and automatic inventory dumping valves have been provided. Erection of barriers, and remote operation control are intended to provide protection for operating personnel. Startup and shut-down on nitrogen is routine operating practice.

3. Liquid Oxygen Pumps

Table VD3 lists pump accidents which are identified as plant or trailer mounted and centrifugal or reciprocating pumps.

Contamination or improper materials appears to be the chief cause of reciprocating pump failures. Centrifugal pump failures are related to mechanical failure of bearings and their lubrication which cause interference between pump parts and case. Design changes involving opening of pump clearances and different materials have been made to minimize the accident recurrence potential. A strict preventive maintenance schedule will cause bearings to be changed before they can become a problem.

4. Oxygen Regulator Accidents

Table VD4 lists regulator accidents which have occurred to APCI manufactured equipment. This class of oxygen equipment is widely used by many people from all walks of life. Most accidents have been caused by actions of persons who do not fully understand the hazards associated with the use of oxygen.

Training is thy key to minimizing the possibility of recurrence of this type accident. Improvement in operating instructions and discussions and demonstrations to industry and technical schools are efforts being made to train as many people as possible.

5. Piping and Lines

Table VD5 lists accidents which have occurred in oxygen piping and line systems. Most accidents are associated with persons unfamiliar with the hazards of oxygen. Training becomes the key to minimizing accidents with this class of equipment.

6. Storage Systems

Table VD6 lists only the major storage system failure accidents which are significantly important to total system safety.

7. Gauges and Instrumentation

Table VD7 lists accidents related to gauges and instrumentation failure. Those accidents pertaining to gauges are associated with contamination due to testing media or handling and storage when not in use usually introduced by persons not fully aware of the hazards associated with oxygen service. Training is the key to minimizing these accidents.

8. Highway and Rail Tankers

No entries are made in Table VD8. Highway and rail tankers have been damaged in accidents, however, the damage resulted not from tank failure but rather from involvement in vehicle or train derailment incidents.

AIR PROCESS PLANT ACCIDENTSV-2 (continued)
Table VD1a
Page 1 of 4

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Plant Size</u> | <u>Plant Component</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|-------------------|------------------------|---|
| 10/56 | Virginia | 0 | 1T/D | H.P. Column | Column ruptured by overpressurization through mis-operation and violation of safety practices---gagging of a safety relief valve. H.P. column extensively damaged, cold box and low pressure. Column slightly damaged. No injuries. |
| 12/3/56 | W. Virginia | 0 | Tonnage | Disposal Vaporizer | Energy release in a purge stream from condensers occurred in vaporizer coils. Believe contaminant concentrated in coils under restricted flow. Ignition source and contaminant unidentified. Localized damage only. No injuries reported. |
| 7/11/57 | California | A | 75T/D | Air Drier | Fire in air drier from oxygen enriched reactivation nitrogen and hot drier. Fire occurred after start-up from a cold shutdown. Damage restricted to drier without burn through. No injuries. |
| 7/12/57 | California | A | 75T/D | Air Drier | Fire in No. 2 oil separator from oxygen enriched reactivation nitrogen and hot drier. Fire occurred after startup from a cold shutdown. Damage restricted to drier without burn through. No injuries. Operational procedure changes eliminated this potential hazard. |
| 3/6/58 | Florida | 0 | 1T/D | L.P. Column | Column ruptured by overpressurization. Line(s) from H.P. column believed to be partially restricted. Damage to H.P. column was extensive. One person was slightly injured. |
| 3/30/58 | Texas | 0 | Tonnage | Total Plant | Leaking LOX from drain line impinged upon carbon steel air line which ruptured in trench containing some oil. Extensively damaged the compressor building, including the control room of the plant. Three (3) persons were killed. |
| 2/9/59 | California | A | 75T/D | Air Drier | A fire occurred in the No. 2 oil separator when process air was introduced in a hot (above 400°F) separator. Minor internal separator damage. No injuries. |

AIR PROCESS PLANT ACCIDENTS

V-2 (continued)
Table VD1a
page 2 of 4

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Plant Size</u> | <u>Plant Component</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|-------------------|--------------------------------|--|
| 4/21/59 | England | 0 | Tonnage | Cold Box | Explosion in air plant cold box external to process equipment caused extensive plant damage and three (3) fatalities. The reaction was determined to be between LOX and oil soaked rock wool. Reported in AIChE Safety in Air and Ammonia Plants, Volume 2, page 36 (Doc. #99000295), and Volume 5, page 1 (Doc. #99000103). |
| 1/4/61 | Germany | 0 | Tonnage | Total Plant | LOX leak penetrated to smoldering wood flooring underneath cold box plates. Extensive damage to entire plant and 15 fatalities occurred. Reported in AIChE Safety in Air and Ammonia Plants, Volume 4, page 70 (Doc. #99000294). |
| 7/61 | England | 0 | 1T/D | L.P. Column | Explosion in top 6 trays of L.P. Column. Details lacking but believe overpressurization involved rather than reaction. Slight damage to cold box. No injuries reported. |
| 8/15/61 | Michigan | 0 | 25T/D | Air line at driers | Fire at driers due to customer cross-tie of oxygen and nitrogen lines. Unapproved field modifications. Damage restricted to piping at driers. No injuries. |
| 1/14/62 | Texas | 0 | 100T/D | Piping | Explosion and fire in drain valve and defrost header on pure oxygen filter. Equipment damage slight. One (1) fatality. |
| 1/26/62 | Florida | 0 | 1T/D | L.P. Column | Column ruptured by overpressurization through mis-operation. Suspected faulty liquid level gauge permitted excessive liquid levels in low pressure column. |
| 5/20/62 | England | 0 | Tonnage | Vaporizer | Reaction between oil and oxygen in LOX disposal vaporizer. One (1) fatality and two (2) injured. |
| 5/26/63 | Delaware | A | Tonnage | Expansion Engine Oil Separator | Fire in reciprocating expander oil separator at start of reactivation cycle. No equipment damage or personnel injuries. |

AIR PROCESS PLANT ACCIDENTS

V-2 (continued)
Table VD1a
Page 3 of 4

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Plant Size</u> | <u>Plant Component</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|-------------------|------------------------|---|
| 7/12/63 | Ohio | A | 75T/D | Air Drier | Air drier heated box ruptured from overpressure due to leaking H.P. drier valve. Slight damage confined to the drier accessories. No injuries. |
| 9/63 | England | A | 100T/D | Air Drier | Drier dust filter involved in fire when air was used to cool down a hot drier vessel. Damage confined to drier filter and piping. No injuries. |
| 12/19/63 | Canada | O | Tonnage | Oil Separator | Reaction with air and oil at -265°F in expansion engine oil-knock out pot. Moderate damage to separator and associated piping. |
| 9/17/64 | England | A | Tonnage | Argon Plant | Hydrogen reaction with oxygen in Deoxo unit. Faulty operation. Damage sustained to vessel support legs and concrete foundation. No. injuries. |
| 2/3/65 | California | A | 75T/D | Expansion Engine | Mechanical failure of engine valve spring and higher than normal oxygen content of process gas reacted with oil accumulation in discharge piping. Piping and valve system extensively damaged. Slight area damage to building and other equipment. No injuries. |
| 3/4/65 | Delaware | A | Tonnage | Expansion Engine | Reaction in expansion engine oil absorber filter carried into piping system. Damage was restricted to piping system and filter media. No. injuries. |
| 9/2/65 | Pennsylvania | A | 34T/D | Safety valve header | LOX spilled from unattended automatic plant through hole in S.V. header after SV functioned. Design error. |
| 12/22/65 | Michigan | O | Tonnage | Vaporizer | Solvent remaining in vaporizer after being cleaned reacted with oxygen when vaporizer placed in service. The vaporizer was extensively damaged. Two (2) fatalities occurred. |
| 1/67 | Illinois | O | Tonnage | Auxiliary Column | Reaction in auxiliary column. Details lacking. |

AIR PROCESS PLANT ACCIDENTS

V-2 (continued)
Table VD1a
page 4 of 4

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Plant Size</u> | <u>Plant Component</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|-------------------|---------------------------|---|
| 7/7/67 | Delaware | A | Tonnage | Expansion Engine | Reaction occurred in oil separator filter. Damage was confined to filter element within the separator vessel. No injuries. |
| 9/18/67 | Pennsylvania | 0 | Tonnage | Hydrocarbon Adsorber | Reaction in hydrocarbon adsorber area. Reaction between oxygen and retained trichlene solvent from previous washout. |
| 10/6/67 | Indiana | 0 | 17T/D | Heat Exchanger Air Header | H.P. Air line ruptured at heat exchanger. Erosion of line caused by water vapor in air circuit. In service 17 years. |
| 1/10/68 | Texas | 0 | 350T/D | Heat Exchanger | Reaction in oxygen circuit of coiled tube heat exchange in dead end of header where fuels could accumulate. Damage was restricted to one end of oxygen header. No injuries. |

0 = Other Companies

A = Air Products & Chemicals

REBOILER REACTIONSV-2 (continued)
Table VD1b
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| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Plant Size</u> | <u>Reboiler Type</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|-------------------|----------------------|---|
| 1/11/56 | Texas | 0 | Tonnage | A | Reboiler reaction caused by nitrous oxide - acetylene crystals. Reported in AIChE, Safety in Air and Ammonia Plants, Volume 2, page 31 (Doc. #99000296). |
| 4/18/56 | Pennsylvania | 0 | Tonnage | B | Ethylene and hydrocarbons concentrated in the reboiler and reacted causing extensive damage to air plant cold box, nitrogen wash column cold box, and accessories in the immediate vicinity. Personnel injury occurred. |
| 8/57 | Germany | 0 | Tonnage | ? | Reboiler reaction caused by hydrocarbons from hot air compressor. |
| 4/24/58 | Canada | 0 | 100T/D | B | Reboiler reaction. Acetylene believed to be involved. Falling oxygen in tubes. A single reboiler tube involved. Reported in AIChE, Safety in Air and Ammonia Plants, Volume 3, page 9 (Doc. #99000297). |
| 1/59 | Philippines | 0 | .6T/D | F | Distillation column reaction. Acetylene in column sump believed to be cause due to acetylene plant location. |
| 2/26/59 | Brazil | 0 | .75T/D | F | Distillation column reaction. Details unknown. |
| 7/15/59 | New Jersey | A | 6.5T/D | A | Slight reboiler reaction possible due to accumulations of hydrocarbons from poor compressor operation and no plant washout. Only indication of reaction was loss of purity. Slight bulge in reboiler shell at bottom tube sheet. No injuries. |
| 8/28/59 | South Dakota | 0 | 1T/D | A | Rupture of joint between high & low pressure column. Insufficient detail to determine cause of reaction. |

REBOILER REACTIONSV-2 (continued)
Table VD1b
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| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Plant Size</u> | <u>Reboiler Type</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|-------------------|----------------------|---|
| 9/30/59 | Canada | 0 | 100T/D | B | Reboiler reaction. Acetylene believed to be involved. Falling oxygen in tubes. Cold box extensively damaged. No injuries. Reported in AIChE, Safety in Air and Ammonia Plants, Volume 3, page 9 (Doc. #99000297). |
| 11/59 | Texas | 0 | 20T/D | ? | Reboiler reaction. Details unknown. |
| 4/20/60 | West Virginia | 0 | Tonnage | C or D | Reboiler reaction. Dry boiling in oxygen passages. Reported in AIChE, Safety in Air and Ammonia Plants, Volume 3, page 12 (Doc. #99000298). |
| 2/20/61 | Mexico | 0 | 2.5T/D | A | Reboiler explosion when contamination reacted due to H.P. oxygen used to unplug lower liquid level line. |
| 3/61 | England | 0 | 1T/D | A | Reboiler reaction, cause undetermined. |
| 5/62 | West Virginia | 0 | Tonnage | C or D | Reboiler reaction. Dry boiling in oxygen passages. |
| 8/62 | Michigan | 0 | 500T/D | C or D | Reboiler reaction. Dry boiling in oxygen passages. |
| 11/62 | Peru | 0 | .75T/D | F | L.P. Column sump and tray damaged in explosion. Details unknown. |
| 11/63 | Ohio | 0 | Tonnage | C or D | Reboiler reaction. Dry boiling in oxygen passages. |
| 2/64 | West Virginia | 0 | Tonnage | C or D | Reboiler reaction. Dry boiling in oxygen passages. |
| 4/2/64 | California | A | 75T/D | B | Reboiler reaction. Hydrocarbon concentrated in single tube when dry boiling occurred. Erratic plant operation was only indication of reaction. |
| 7/19/64 | England | 0 | Tonnage | C or D | Reboiler reaction. Details unknown. |
| 10/64 | England | 0 | Tonnage | C or D | Reboiler reaction. Details unknown. |
| 11/6/64 | California | A | 75T/D | B | Reboiler reaction. Undetermined contamination concentrated in single tube when dry boiling occurred. Loss of purity and H.P. column pressure, and increase of L.P. column pressure only indication of reaction. |

REBOILER REACTIONSV-2 (continued)
Table VDIb
page 3 of 3

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Plant Size</u> | <u>Reboiler Type</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|-------------------|----------------------|--|
| 1/65 | Columbia | O | 1.5T/D | A | Condenser reaction destroyed plant. Details unknown. |
| 3/29/65 | England | A | 200T/D | B | Reboiler reaction in a single tube at liquid level submergence line. Cause undetermined. Loss of purity was only indication of reaction. |
| 2/7/66 | Puerto Rico | O | 2.5T/D | A | Reboiler tubes crushed, reboiler bulged, liquid level and oxygen drain ruptured. Cause undetermined. |
| 11/20/66 | Peru | O | .75T/D | F | Explosion in oxygen subcooler. Details unknown. |
| 1/67 | Illinois | O | Tonnage | ? | Explosion in side arm column. Details unknown. |
| 10/27/67 | California | A | 75T/D | B | Reboiler reaction. Contamination concentrated in tube when dry boiling occurred. |
| 8/5/68 | California | A | 75T/D | B | Reboiler reaction. Contamination concentrated in tube when dry boiling occurred. |
| 10/5/68 | California | A | 75T/D | B | Reboiler reaction. Contamination concentrated in tube when dry boiling occurred. |
| 12/25/68 | California | A | 75T/D | B | Reboiler reaction. Contamination concentrated in tube when dry boiling occurred. |
| 3/24/70 | Venezuela | O | 5T/D | A | Plant exploded. Details unknown. |
| 6/18/70 | Jamaica | O | 2.5T/D | A | Reboiler explosion believed caused by acetylene in reboiler. |
| 6/9/71 | Pennsylvania | O | Tonnage | C or D | Reboiler reaction. Faulty liquid level gauge which indicated 100% submergence instead of actual 85%. Cause dry boiling in the condenser. |

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O - Other Companies

A - Air Products and Chemicals, Inc.

OXYGEN COMPRESSOR ACCIDENTSV-2 (continued)
Table VD2
Page 1 of 3

A reaction within an oxygen compression system is usually of short duration although violent. The damage to the equipment is often severe. Usually, any evidence which can be useful in determining cause is destroyed in the reaction.

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Type of Compressor</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|---------------------------|---|
| - | Indiana | 0 | Centrifugal | Evidence of internal reaction found during normal maintenance. |
| - | Illinois | 0 | Centrifugal | Oxygen compressor rotating backward without oil lubrication to bearings. Overheating ignited hot oil vapors. |
| Early '50 | Europe | 0 | Reciprocating | Four reactions with fire origin in thin top section of 4th stage piston. |
| Late '50 | South Africa | 0 | Centrifugal | No details. |
| 1950 | Europe | 0 | Centrifugal | Instabilities caused by operating too close to second critical speed. |
| 2/27/58 | Michigan | 0 | Reciprocating | No details. |
| 1/15/59 | Michigan | 0 | Centrifugal | Reaction in high pressure casing between the last stage wheel and balancing piston. No injuries reported. Cause undetermined. |
| 5/59 | England | 0 | Reciprocating | Grease left on valve springs after overhaul reacted with oxygen on compressor startup. |
| 7/10/59 | Louisiana | 0 | Centrifugal | Corrosion products caused by water leakage caused frictional heating and ignition in the balance piston area. |
| 1960 | Italy | 0 | Centrifugal | No details. |
| 2/9/60 | California | 0 | Reciprocating | Third stage oxygen compressor fire ruined the cylinder and blew off one of the valve covers. No injuries. |
| 1960 | Europe | 0 | Centrifugal | Instabilities caused by operating too close to second critical speed. |

OXYGEN COMPRESSOR ACCIDENTSV-2 (continued)
Table VD2
Page 2 of 3

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Type of Compressor</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|---------------------------|---|
| Late '60 | Luxembourg | 0 | Reciprocating | Bolt from cooler area dropped into piston-cylinder area and caused fire. |
| 6/22/61 | Michigan | 0 | Reciprocating | No details. Newspaper report indicates three (3) fatalities. |
| 7/7/64 | Louisiana | 0 | Centrifugal | Reaction believed caused by backflow of flammable fluids from another process. |
| 1965 | Germany | 0 | Reciprocating | Broken piston rod caused reaction. |
| 1967 | France | 0 | Reciprocating | Reaction caused by broken piston. |
| 1967 | India | 0 | Centrifugal | No details. |
| 12/67 | Poland | 0 | Centrifugal | Reaction occurred shortly after startup. Improper cleaning after long term storage believed to be cause. |
| 1968 | Germany | 0 | Centrifugal | Oxygen compressor rotating backward without oil lubrication to bearings. Overheating ignited hot oil vapors. |
| 4/68 | Scotland | 0 | Reciprocating | Water and corrosion material from leak in after cooler appears to be part of the cause of the reaction. Worker seriously injured. |
| 6/17/68 | Louisiana | 0 | Centrifugal | Particle appears to have entered compressor intake and caused case to impeller interference. No injuries. |
| 6/28/68 | Maryland | A | Centrifugal | High pressure case reaction may be associated with major electrical failure which occurred at the same time. |
| 9/68 | Holland | 0 | Centrifugal | No details. |
| 10/14/68 | Louisiana | 0 | Centrifugal | A fatality occurred when the rebuilt oxygen compressor of June 1968 accident failed upon initial startup. |
| 12/14/68 | West Virginia | A | Centrifugal | A routine internal inspection revealed that a reaction occurred at some previous startup without involving the compressor. A labyrinth seal was installed backward. |

OXYGEN COMPRESSOR ACCIDENTS

V-2 (continued)
Table VD2
Page 3 of 3

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Type of Compressor</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|---------------------------|---|
| 12/27/68 | Pennsylvania | 0 | Centrifugal | Improper cleaning in discharge volute believed cause of fire in discharge of compressor. |
| 3/18/69 | Ohio | A | Centrifugal | Low pressure case burn through. Mechanical failure in thrust bearing area caused shaft to shift. Fire started in fourth stage and burned through into second stage. |
| 4/4/69 | Illinois | 0 | Centrifugal | Reaction occurred on startup of compressor. |
| 4/15/69 | Pennsylvania | 0 | Centrifugal | Origin of fire appears to be in the seventh stage of the high pressure case. No injuries reported. Details concerning cause are lacking. |
| 6/69 | Germany | 0 | Centrifugal | Dirty intercoolers believed to be cause. |
| 12/5/69 | California | A | Centrifugal | High and intermediate pressure case of compressor burned through causing one (1) fatality and injury to eight (8) others. |
| 1969 | Japan | 0 | Centrifugal | No details. |

0 - Other Companies

A - Air Products and Chemicals, Inc.

LIQUID OXYGEN PUMP ACCIDENTS

V-2 (continued)
Table VD3
Page 1 of 4

The cause of many LOX pump accidents has been established only with difficulty as most of the evidence needed to determine cause has been destroyed in the reaction.

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Type of Pump</u> | <u>Trailer of Plant Mounted</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|---------------------|---------------------------------|---|
| 3/19/57 | Canada | 0 | Centrifugal | Plant | Pump seized resulting in fire. |
| 8/13/57 | Ohio | 0 | - | Trailer | Pump exploded during transfer of LOX. No details. |
| 1/22/60 | California | A | Reciprocating | Trailer | Fire occurred while pump under test. Plunger rod material of questionable compatibility. One (1) fatality, two (2) injured. |
| 2/11/60 | Pennsylvania | A | Reciprocating | Plant | Involved only the mechanical failure of pump barrel. No combustion reaction involved. |
| 12/60 | - | 0 | Reciprocating | Plant | Pump explosion due to peeling of chrome plating on pump rod and subsequent ignition. |
| 8/28/61 | Illinois | 0 | Centrifugal | Trailer | Tanker fire and explosion believed to have occurred during transfer of LOX to plant storage. Reported in AIChE, Safety in Air and Ammonia Plants, Volume 4, page 49 (Doc. #99000299). |
| 2/1/62 | Pennsylvania | A | Centrifugal | Plant | Hydrocarbon accumulation in multi-stage pump. Reaction is discussed in AIChE, Safety in Air and Ammonia Plants, Volume 5, page 41 (Doc. #99000300). |
| 11/12/62 | Pennsylvania | A | Reciprocating | Plant | Oil contaminated interconnecting. Tubing was also pressure underrated. Reaction caused injury to to three (3) persons. |
| 3/6/63 | Pennsylvania | 0 | Centrifugal | Plant | Oil contamination in LOX lines and pump ignited upon starting a warm pump. One (1) fatality and three (3) injured. Plant equipment severely damaged in air of reaction. Reported in AIChE, Safety in Air and Ammonia Plants, Volume 6, page 41 (Doc. #99000261A). |

LIQUID OXYGEN PUMP ACCIDENTS

V-2 (continued)
Table VD3
Page 2 of 4

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Type of Pump</u> | <u>Trailer of Plant Mounted</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|---------------------|---------------------------------|--|
| 10/11/63 | Sweden | 0 | Reciprocating | Plant | Substitution of pump rod material and application of chrome plating to rod caused peeling of plating material which reacted with oxygen to cause fire. |
| 10/24/63 | Sweden | 0 | Reciprocating | Plant | Substitution of pump rod material and application of chrome plating to rod caused peeling of plating material which reacted with oxygen to cause fire. |
| 12/4/63 | Maryland | A | Reciprocating | Plant | Mechanical failure of connecting rod due to excessive tightening of pump packing. |
| 12/16/63 | England | A | Centrifugal | Trailer | Believe bearing failure caused interference between pump impeller and case with subsequent ignition. One (1) person slightly injured. 17 |
| 5/21/66 | Ohio | 0 | Centrifugal | Plant | Fire in LOX pump caused by thrust bearing failure attributed to water in lubricant. One (1) person injured. Reported in AIChE, Safety in Air and Ammonia Plants, Volume 9, page 5 (Doc. #99000301). |
| 5/23/66 | Ohio | 0 | Centrifugal | Plant | Believe foreign object entered pump and initiated reaction. Pump was replacement for 5/21/66 pump accident. No injuries. Reported in AIChE, Safety in Air and Ammonia Plants, Volume 9, page 5 (Doc. #99000301). |
| 9/2/66 | England | 0 | Centrifugal | Trailer | LOX tanker exploded when submerged LOX pump failed. Two (2) people killed and seventeen (17) injured. |
| 10/6/66 | Louisiana | 0 | Centrifugal | Trailer | LOX pump fire during transfer of product to storage. |
| 11/3/66 | Germany | 0 | - | Trailer | Fire started during transfer of LOX from trailer to storage. |

LIQUID OXYGEN PUMP ACCIDENTS

V-2 (continued)
Table VD3
Page 3 of 4

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Type of Pump</u> | <u>Trailer of Plant Mounted</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|---------------------|---------------------------------|---|
| 12/21/66 | Florida | 0 | Centrifugal | Trailer | Believe foreign object entered pump and initiated reaction. |
| 10/13/67 | Pennsylvania | 0 | Reciprocating | Plant | Fire in pump originating in area of insulating seal and seal nut believed caused by tight pump packing. |
| 2/26/68 | Louisiana | A | Centrifugal | Plant | Oxygen from pump packing entered lower motor bearing case where reaction occurred damaging motor. |
| 3/3/68 | England | A | Centrifugal | Trailer | Bearing wear caused interference between pump impeller and case. |
| 12/68 | Pennsylvania | 0 | Centrifugal | Plant | Foreign material entered pump and impacted impeller. |
| 12/68 | Pennsylvania | 0 | Centrifugal | Plant | Bearing failure occurred. Pump was stopped before damage to pump internals. No fire occurred. |
| 1/22/69 | Germany | 0 | - | Trailer | Tanker under test when control end caught fire. No other details. |
| 2/26/69 | Belgium | A | Centrifugal | Plant | Poor lubrication permitted bearing wear which eventually caused interference between pump impeller and case and subsequent fire. No injuries. |
| 9/69 | Delaware | A | Centrifugal | Trailer | Fire in pump restricted to bearing case. Bearing and pump seal failure. No injuries. |
| 10/69 | Delaware | A | Centrifugal | Trailer | Fire in pump restricted to bearing case. Bearing and pump seal failure. No injuries. |
| 12/14/69 | Pennsylvania | A | Centrifugal | Trailer | Bearing wear caused interference between pump impeller and case. |

LIQUID OXYGEN PUMP ACCIDENTS

V-2 (continued)
Table VD3
Page 4 of 4

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owned or Operated</u> | <u>Type of Pump</u> | <u>Trailer of Plant Mounted</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|---------------------|---------------------------------|---|
| 1/70 | England | A | Centrifugal | Trailer | Bearing wear caused interference between pump impeller and case. |
| 5/70 | France | A | Centrifugal | Trailer | Bearing wear caused interference between pump impeller and case. Two (2) persons injured in fire. |
| 6/3/70 | England | A | Centrifugal | Plant | Bearing wear caused interference between pump impeller and case with subsequent ignition. No injuries. |
| 8/7/70 | England | A | Centrifugal | Plant | Parts of pump inlet filter is believed to have entered pump and caused interference between impeller and case with subsequent ignition. |
| 8/17/70 | Pennsylvania | O | Centrifugal | Plant | Cause appears to be bearing failure which permitted pump parts interference with subsequent ignition. No injuries. |
| 9/8/70 | Puerto Rico | A | Centrifugal | Plant | Pump failure caused by sequence of lubrication failure, bearing failure, rubbing contact, and ignition. No injuries reported. |
| 2/17/71 | England | A | Centrifugal | Trailer | Contamination in pump under test believed to be cause of reaction. One (1) fatality and two (2) injured. |
| 3/5/71 | England | A | Reciprocating | Plant | Mechanical failure of internal pump parts supplied the source necessary to ignite the pump materials of construction. |

O - Other Companies

A - Air Products and Chemicals, Inc.

OXYGEN REGULATOR ACCIDENTS

V-2 (continued)

Table VD4

Page 1 of 3

Reactions which occur in oxygen regulators usually result in complete destruction of the regulator. The reaction usually occurs when the operator is operating his supply valves or adjusting the regulator resulting in injury, usually serious, to the operator. The exposure is initially to thermal burns by hot metal, followed by exposure to oxygen which supports the combustion vigorously. The table lists the area of the regulator involved and the apparent cause of the reaction.

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---|
| 5/15/67 | Texas | No details. |
| 7/14/58 | New York | No details. |
| 8/22/58 | New York | No details. |
| 1958 | New Jersey | Repairs by others. |
| 7/59 | New York | No details. |
| 6/20/60 | Indiana | H.P. side reaction. Repairs by others. |
| 9/22/60 | New Jersey | H.P. side reaction. Cause not determined. Regulator attached to tube trailer. Moderate damage to customer property. |
| 12/9/60 | West Virginia | H.P. side reaction. Cause unknown. |
| 9/4/61 | Ohio | L.P. side reaction. Cause unknown. |
| 4/24/62 | Pennsylvania | Involved in fire but not cause of reaction. Incorrect operating procedures. |
| 6/22/62 | Arkansas | H.P. side reaction. Source of fuel from portable acetylene generator believed to be contributory. |
| 6/22/62 | Ohio | No details. Oxygen-acetylene outfit in fire. |
| 5/20/63 | Maryland | H.P. side reaction. Operating procedure believed to be cause. |
| 11/21/62 | New Jersey | L.P. side reaction. Operating procedure believed to be cause. |

OXYGEN REGULATOR ACCIDENTS

V-2 (continued)
Table VD4
Page 2 of 3

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---|
| 8/26/63 | Pennsylvania | H.P. side reaction. Dirt in an uncleaned part of system was cause of reaction. |
| 1/27/64 | Maryland | Hydrogen in oxygen system reacted. System design was cause. |
| 5/13/64 | Pennsylvania | L.P. side reaction. Operating procedure was cause. |
| 5/22/64 | Pennsylvania | Improper equipment maintenance was cause. |
| 5/25/64 | Pennsylvania | L.P. side reaction. Operating procedure was cause. |
| 7/14/64 | Michigan | L.P. side reaction. Equipment in poor repair. |
| 10/31/64 | Maryland | 3 regulators involved. Hydrogen in oxygen system. System design was cause. |
| 1/65 | Oklahoma | Defective regulator was tested with oxygen to determine repairs required. Operator procedure incorrect. |
| 8/30/65 | Virginia | No details. |
| 9/65 | Virginia | No details. |
| 1/1/66 | Georgia | L.P. side reaction. Operating procedure was cause. |
| 3/13/66 | Pennsylvania | L.P. side reaction. Operating procedure was cause. |
| 8/27/66 | Illinois | H.P. side reaction. Operating procedure appears to be cause. |
| 3/15/67 | Virginia | H.P. side reaction. Contamination introduced to regulator during repairs. |
| 5/10/67 | Alabama | H.P. side reaction. Contamination introduced during repairs. |
| 5/24/67 | Pennsylvania | L.P. side reaction. Operating procedure appears to be cause. |
| 7/25/67 | New York | H.P. side reaction. Improper repairs may be cause. |
| 10/21/68 | Ohio | Reaction appears to have initiated in H.P. gauge bourdon tube. Cause undetermined. |

OXYGEN REGULATOR ACCIDENTS

V-2 (continued)
Table VD4
Page 3 of 3

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---|
| 4/69 | Maryland | L.P. side reaction. No details. |
| 5/69 | Maryland | L.P. side reaction. No details. Same regulator as April 1969. |
| 5/29/69 | Maryland | H.P. side reaction. Origin of reaction outside of regulator in cylinder valve or valve passages and involved the regulator. |
| 11/69 | Michigan | A series of L.P. side reactions caused by improper design of fuel system for cold weather operation. |
| 11/69 | Missouri | A series of L.P. side reactions caused by improper design of fuel system for cold weather operation. |
| 1/30/69 | Alabama | H.P. side reaction. Contamination introduced through local repair. |
| 10/17/69 | Pennsylvania | H.P. side reaction. Origin of this reaction is the oxygen cylinder valve seat. |
| 1/8/70 | New Jersey | H.P. side reaction. Cause undetermined. |
| 5/1/70 | California | Jetcut machine extensively damaged by back-fire of oxy-fuel mixture caused by incorrect tips and damaged seating surfaces. |
| 5/7/70 | Tennessee | H.P. side reaction. Origin of reaction appears to be oxygen cylinder valve seat. |
| 6/23/70 | Arkansas | H.P. side reaction. Insufficient details, however, work are contaminated heavily with oil and grease. |
| 11/23/70 | Virginia | Poor practice of changing regulator from one product service to oxygen service without complete disassembly and solvent wash. |
| 3/5/71 | North Carolina | H.P. side reaction. Origin of reaction is external to regulator. |
| 6/22/71 | Michigan | Jetcut machine involved in fire which originated in electrical system. One torch was also defective. |

PIPING AND LINE ACCIDENTS

V-2 (continued)
Table VD5
Page 1 of 2

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owner or Operator</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|---|
| 10/28/58 | California | APCI | Leak in transfer hose connection between tanker and storage permitted LOX to penetrate asphalt paving. Explosion occurred when driver jumped from tanker to paving seriously injuring the driver and helper. |
| 12/4/58 | California | Other | Fire burned through valve and piping system connected to six (6) high pressure tubes, four (4) of which became projectiles upon release of residual pressure. Evidence of noncompatible materials in the system with an ignition source associated with friction, velocity, and adiabatic compression when a closed valve was opened. No injuries, but serious property damage. |
| 1/9/60 | Connecticut | APCI | Rubber high pressure hose ruptured and ignited during transfer of gaseous oxygen from tube trailer to storage system. Material not compatible in oxygen service. Driver was seriously injured. |
| 8/29/61 | Ohio | APCI | High pressure stainless steel piping ignited and burned. Oil and carbon steel rod were found in system. Sabotage suspected. No injuries. |
| 7/16/62 | Ohio | Other | Regulator station and associated piping feeding oxygen to steel mill furnace seriously damaged when reaction occurred within a system shut-off valve. Compatibility of material in one valve is suspected. An excess flow valve closed off the supply of oxygen to the fire to limit the area of fire involvement. |
| 7/19/62 | Kansas | Other | Underground drain system exploded after excess LOX from storage entered drain. Dirt in drain and drain pipe embrittlement. |
| 4/3/63 | Tennessee | APCI | High pressure oxygen line ruptured due to reaction of small amount of fuel and incorrect pressure rating of pipe material. |
| 6/12/64 | Illinois | APCI | High pressure oxygen flexible transfer line failed at fitting. Field repairs were made incorrectly. |
| 6/64 | Minnesota | Other | Failure of piping and manifold system for high pressure oxygen. System fabricated of low pressure pipe, noncompatible material, and valve stems lubricated with hydrocarbon oil. One person seriously injured. |

PIPING AND LINE ACCIDENTS

V-2 (continued)

Table VD5

Page 2 of 2

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owner or Operator</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|--|
| 11/12/64 | West Virginia | Other | New carbon steel shop line solvent washed and dried with oil laden shop air. Reaction occurred when oxygen flow was stopped after first use of line. |
| 9/26/65 | West Virginia | Other | Fire in suction line to an oxygen compressor occurred when the suction shutoff valve chain operator failed causing the valve to lock partially open. Change of velocity of the gas through the valve is suspected of being ignition source for the valve material. One man fatally injured. |
| 4/29/66 | Louisiana | APCI | Damaged and cracked insulation on a liquid hydrogen piping system permitted air to be liquefied against the cold pipe surfaces. Some distillation caused oxygen enrichment of the liquid air which accumulated in the insulation. It is believed some hydrogen leak in the piping system reacted with the oxygen rich air causing damage to the insulation and line. Ignition source is unknown. No injuries reported. |
| 1966 | Pennsylvania | Other | Embrittlement failure of 400' of carbon steel line due to excessive draw of LOX from storage and vaporizer system. Temperature control valve on outlet side of vaporizer did not respond quickly enough. |
| 7/12/68 | Ohio | Other | Buna "N" seat of ball valve ignited during blowout of new line with oxygen. Incorrect material for the service. |
| 1/21/69 | West Virginia | Other | Reaction in high pressure oxygen manifold and piping system possibly due to residual fuel gas in one of cylinders being processed. |
| 4/70 | Ohio | Other | Reaction in high pressure oxygen manifold and piping system possibly due to residual fuel gas in one of cylinders being processed. |

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STORAGE SYSTEM ACCIDENTS

V-2 (continued)
Table VD6
Page 1 of 1

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owner or Operator</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|---|
| 8/25/64 | California | APCI | A check valve installed in the piping of a LOX storage tank lost its bonnet due to improper assembly or working loose during flow conditions. Thirty-four thousand (34,000) gallons of LOX spilled before corrective measures could be taken. Water was effectively used to vaporize the LOX without a reaction occurring. |
| 8/19/66 | Florida | Other | Eight hundred thousand (800,000) gallons LOX spilled when flex line segment of pump suction line failed. A large area was affected by the spill including a macadam road. Water effectively vaporized the LOX without incident. |
| 11/26/66 | California | APCI | A new 190,000 gallon LOX tank developed a leak in the inner tank during initial filling operations. The leak developed when the tank was about 1/3 full. Product was transferred to tankers and moved to other storage areas without incident or without the loss of any significant amounts of LOX. |
| 5/13/68 | Pennsylvania | Other | A weld joint in the LOX fill-drain line of a large storage tank failed. The location of the line in the space between the inner and outer vessels exposed the outer carbon steel vessels to cold product. When failure of the outer shell occurred, approximately 215,000 gallons of LOX spilled into the area. Water was used to vaporize the spilled product without incident. (Ball, W. L., LOX Spill, APCI Doc. #99000220). |
| 2/24/71 | Pennsylvania | APCI | A 6,000 gallon tank toppled during filling with LOX when a concrete pad failed. Surface water seeped through a small crack in the pad and eroded the ground beneath the pad. The tank sustained light damage as did the vehicle against which the tank came to rest after toppling. No fire or injuries. |

GAUGES AND INSTRUMENTATION ACCIDENTS

V-2 (continued)
Table VD7
Page 1 of 1

| <u>Date of Accident</u> | <u>Location of Accident</u> | <u>Equip. Owner or Operator</u> | <u>Remarks</u> |
|-------------------------|-----------------------------|---------------------------------|--|
| 11/26/58 | Florida | Other | The product from a LOX tanker was being transferred into storage. A meter connected in this line was not properly cooled-down when the flow started. The resulting vaporization of LOX caused the meter to overspeed with resulting increase in temperature and ignition of materials. The ensuing fire, supplied by LOX from the trailer, involved two (2) tankers, a 30,000 gallon LOX tank, another vehicle, and support equipment. |
| 4/15/59 | Pennsylvania | APCI | A gaseous oxygen flow meter used to measure vaporization from a storage tank was exposed to liquid oxygen temperatures when the storage tank was overfilled. The meter ruptured from metal embrittlement and overpressurization, caused by the vaporizing LOX. No injuries involved. Shrapnel damage existed in the immediate area. |
| 5/23/61 | Illinois | APCI | Oxygen test gauge exploded during cylinder testing operation. Using same gauge in several services may have contaminated it. Slight injuries. Safety glasses saved the operator's eyes. |
| 2/4/64 | Tennessee | APCI | Oxygen test gauge exploded during cylinder testing operation. Using same gauge in several services may have contaminated it. Slight injuries. Safety glasses saved the operator's eyes. |
| 3/23/64 | Pennsylvania | APCI | Oxygen manifold gauge fire and explosion. Hydrocarbon oil used in dead weight tester contaminated gauge which was in daily service for six (6) months prior to accident. Position of gauge above line of sight prevented injury. |
| 2/6/67 | Missouri | APCI | Oxygen test gauge failure due to contamination from use in different product service or from cylinder valve seat failure. One man blinded. |
| 6/29/67 | Iowa | APCI | The operator failed to read the gauge face label which stated "Do not use in Oxygen Service" because the gauge was dead weight tested with hydrocarbon oil. The gauge exploded when placed in an oxygen cylinder for a pressure check. Safety glasses saved the operator's eyes. |
| 6/12/68 | Minnesota | APCI | Test gauge failure due to contamination from use in different product service. A rubber connecting pigtail hose may have also been the source of contamination which contributed towards the reaction. |

LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

V. Accident/Incident Investigation and Report

The following is a series of APL Safety Bulletins and APL Safety Department Reports related to accidents involving oxygen:

- (1) APL, Fire in Oxygen Line, APL Safety Bulletin No. 28, Reprinted January 1968 (Doc. #99000382).
- (2) Everson, I., Accident at an Oxygen Charging Manifold, APL Safety Bulletin No. 46, (Doc. #99000383).
- (3) Everson, I., Accident Arising from Vented Oxygen Manifolds Connected to a Common Vent Pipe, APL Safety Bulletin No. 75, December 11, 1969, (Doc. #99000384).
- (4) Everson, I., More Accidents on Oxygen Equipment, APL Safety Bulletin No. 102, February 8, 1971, (Doc. #99000385).
- (5) Everson, I., and J. S. Lanba, Burckhardt Oxygen Compressor Fire at SSPC Rognac Plant 3/2/71 (Abstracted from Report JSL/NB - 1293 by J. S. Lanba), APL Safety Bulletin No. 107, April 14, 1971, (Doc. #99000386).
- (6) Gillott, E., and I. Everson, Failure of Brazed Joints in High Pressure Gaseous Oxygen Line at a Cylinder Filling Depot, APL Safety Bulletin No. 114, July 13, 1971, (Doc. #99000387).
- (7) Everson, I., and P. Cook, Preliminary Report on Accident at Zelzate Plant 26th February 1969 When an Explosion and Fire Occurred in Burckhardt Centrifugal LOX Pump, Type GB114, No. 29224, APL Safety Department Report No. 16, February 28, 1969, (Doc. #99000388).
- (8) Croxford, B. J., I. Everson, and R. Naylor, Report on Explosion of LOX Pump on Tanker 400-11, 7th January, 1970 at John Summers' Steel Works, Shotton. Pump Type GB114, Serial No. 79, APL Safety Department Report No. 26 (Preliminary), January 15, 1970, (Doc. #99000389).
- (9) Everson, I., Accident at T. Turner Ltd., Park Lane, Royton, Oldham, Lancs., 11:40 a.m., Saturday, 2nd May 1970, APL Safety Department Report No. 30 (Preliminary), May 5, 1970, (Doc. #99000390).

- (10) Everson, I., Investigation of Valve Fires at Texas Instruments Ltd., Bedford, APL Safety Department Report No. 31, Rev. 1, February 11, 1971, (Doc. #99000391).
- (11) Everson, I., Explosion and Fire Due to the Cryostar GB114 LOX Pump on an SSPC LOX Tanker, APL Safety Department Report No. 32, July 10, 1970, (Doc. #99000392).
- (12) Everson, I., Investigation of Cryostar LOX Pump Explosion at Stoke Plant: 7th August, 1970, APL Safety Department Report No. 34 (Preliminary), August 24, 1970, (Doc. #99000393).
- (13) Coulson, K. J., B. J. Croxford, and I. Everson, Report on Explosion of Cryostar GB.114 Pump No. C.75 on Tanker 400-11 17th February 1961 at the Carrington Plant, APL Safety Department Report No. 35, March 5, 1971, (Doc. #99000394).
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- (17) APL, Experiments with Liquid Oxygen, APL Safety Bulletin No. 25, Reprinted January 1968 (Doc. #99000419).
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LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA

V. Accident/Incident Investigation and Report

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- (2) Kitson, F. K., Fire in Oxygen Line, APCI Safety Gram No. 5, October 20, 1961 (Doc. #99000002).
- (3) Kitson, F. K., Liquid Oxygen Loading, APCI Safety Gram No. 6, November 17, 1961 (Doc. #99000003).
- (4) Kitson, F. K., Approved Alloy Steels in Cryogenic Service, APCI Safety Gram No. 10, Revision 1, October 25, 1963 (Doc. #99000004).
- (5) Schmoyer, W. W., Oxygen Cylinder Failure, APCI Safety Gram No. 13, June 1, 1962 (Doc. #99000005).
- (6) Kitson, F. K., Isolation of Piping Systems, APCI Safety Gram No. 21, October 29, 1962 (Doc. #99000006).
- (7) Schmoyer, W. W., Drain Line Explosion, APCI Safety Gram No. 24, January 17, 1963 (Doc. #99000008).
- (8) Schmoyer, W. W., Sniff Those Cylinders Before Refilling, APCI Safety Gram No. 31, August 21, 1963 (Doc. #99000010).
- (9) Schmoyer, W. W., Vacuum Pump Failures, APCI Safety Gram No. 35, October 4, 1963 (Doc. #99000011).
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- (11) Schmoyer W. W., Human Torches, APCI Safety Gram No. 50C, January 3, 1966 (Doc. #99000013).
- (12) Schmoyer, W. W., Oxygen Regulators in the Welding Industry, APCI Safety Gram No. 60C, November 26, 1967 (Doc. #99000014).
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- (16) Walde, R. A., Flammability and Explosion Hazards -- Plant Wash-Out Studies Cellulube 300, DTE 103, Cellulube 200, Recent Fires at DuPont New Johnsonville Plant, Titanium, Titanium Dioxide, Solnus 500, Hydrocarbon Oil, Titanium Tetrachloride, APCI MAR 87-0-8822, August 1963 (Doc. #99000074).
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- (18) Walde, R. A., Flammability and Explosion Hazards -- Plant Wash-Out Studies Cellulube 300, Cellulube 220, APCI MAR 87-0-8822, July 1963 (Doc. #99000076).
- (19) APCI, Instrumentation -- Modification to Existing Pressure Gauges Snubber, APCI Design Engineering Standard 531.10.2, December 5, 1961 (Doc. #99000282).
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| 9900000330 | KITSON,F.K. | APCI | LIQUID OXYGEN LOADING | APCI-SAFETY-GRAM-NO-06 | 1P | 11/17/61 | |
| 9900000340 | KITSON,F.K. | APCI | APPROVED ALLOY STEELS IN CRYOGENIC SERVICE | APCI-SAFETY-GRAM-NO-10-REV-1 | 1P | 10/25/63 | |
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| 9900000610 | APCI | PIPING | DRY OXYGEN SERVICE | -20F TO 100F | 275-PSIG-MAX | CARBON-STEEL | APCI-DES-ENG-STD-578.60.4 |
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 990001080 HIMMELBERGER.F. APCI NOTES ON LIQUID OXYGEN CONTAMINANTS MISSILE-PROGRAM 10P 1/6/58
 990001090 KEHAT.E. APCI DEVELOPMENT OF STANDARD IGNITION TEST APCI-PROJECT-NO-87-U-8820/1 8P 11/17/61
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 OLYVINYLCHLORIDE, PLASTIC LEAD SEAL-NO-2-JOHN CRANE APCI-MEMO-59 01/28/59 2P
 990001120 GENT.H.L. APCI PUTTI-ROPE ANALYSIS FOR OIL CONTENT AND FLAMMABILITY TEMPERATURE APCI-MEMO-59 12/11/5
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 990001130 WALDETR.A. APCI GASEOUS OXYGEN COMPATIBILITY OF CROSSLITE FLUOROCARBON TAPE THREE-M-FLUOROCARBON-TAPE, P
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 990001140 YODER.L. APCI T-FILM THREAD COMPOUND, AUTOIGNITION TEST APCI-ANAL-REP-61-683 APCI-IWO-NU-80-0068 1P
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 990001150 FREDERICK.L. APCI TEFLON TAPE PERCENT ETHER EXTRACTABLE CONTAMINANTS AND FLUORESCENCE DAMCO-TEFLON TAPE,
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 990001160 YODER.L. APCI TAPE-SEAL THREAD LUBRICANT AND SEALER TAPE-SEAL FROM FRIEISLAND-PLASTIC COMPANY, PERMAC

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 990001480 BROPHY,M. APCI PIPE BURNING TESTS APCI-R&D-NOTEBOOK-111 P26-9 4P 4/17/61
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 990001590 APCI PIPING-IAA4- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 400-PSIG-MAX-OWG ALUMINUM-T
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 990001630 APCI PIPING-CT4- COLD-BOX-SERVICE 100F AND BELOW 400-PSIG-MAX-OWG COPPER-TUBE APCI-DES-ENG-STD-574.1
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 990001690 APCI PIPING-CS2.7- GENERAL-SERVICE -20F TO 100F 275-PSIG-MAX-OWG CARBON STEEL APCI-DES-ENG-STD-578.1
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 990001700 APCI PIPING-CS7.2- GENERAL-SERVICE -20F TO 100F 720-PSIG-MAX-OWG CARBON STEEL APCI-DES-ENG-STD-
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 990001730 APCI PIPING-CS30- GENERAL-SERVICE -20F TO 100F 3600-PSIG-MAX-OWG CARBON STEEL APCI-DES-ENG-STD-578.1
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 -STD-578.30.2 4P 11/67
 990001760 APCI PIPING-SS6- COLD-BOX-SERVICE 100F AND BELOW 615-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-5
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 990001770 APCI PIPING-SS12- COLD-BOX-SERVICE 100F AND BELOW 1235-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG
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 990001780 APCI PIPING-SS17- COLD-BOX-SERVICE 100F AND BELOW 1715-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-
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990001790 APCI PIPING-SS30- COLD-BOX-SERVICE 100F AND BELOW 3000-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG
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990001800 APCI PIPING-SS36- COLD-BOX-SERVICE 100F AND BELOW 3600-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG
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990001810 APCI PIPING-SS7.2- COLD-BOX-SERVICE 100F AND BELOW 720-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG
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990001820 APCI PIPING-SSL1.5- LUBE-OIL-SERVICE -20F TO 150F 150-PSIG-MAX STAINLESS STEEL-PIPE APCI-DES-ENG-STD
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990001830 APCI PIPING- INTRODUCTION HAND VALVE-CODE APCI-DES-ENG-STD-579.3 12P 1/63

990001840 APCI PIPING-CSL.5- GENERAL-SERVICE -20F TO 100F 150-PSIG-MAX-OWG CARBON STEEL-PIPE APCI-DES-ENG-STD-
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990001850 FCSTER,R.H. APCI COLD TEST OF 1/2-INCH SAFETY VALVE WITH CARBON STEEL SPRING APCI-IWO-NO-10-7071 AP
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990001870 BAILEY,B. APCI IGNITION-LIMITS OF CARBON STEEL IN OXYGEN-NITROGEN-ATMOSPHERES APCI-IWO-NO-LB-0043 AP
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990001890 PECKHAM,H.M. HAUSER,R.L. MARTIN CO COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN METHYL-CHLORIDE, METH
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LYBDENUM-DISULFIDE, GRAPHITE, ELECTROFILM-SPRAYABLE-A, DRILUBE-1, TEFLON DISPERSION-T-FILM, HYDROCARBON-GREA
SE, HYDRAULIC-OIL, CHLORINATED-BIPHENYL-AROCOR-1254, GRAPHITE-CHLOR-BIPHENYL, VINYL-CHLORIDE, CIS-DICHLOROE
THYLENE, TRANS-DICHLOROETHYLENE, VINYLIDENA-CHLORIDE, TRICHLOROETHYLENE, ETHYL-ALCOHOL, METHYL-ETHYL-KETONE,
KEROSENE, GLYCERINE, POLYETHYLENE-LOW-DENSITY, POLYETHYLENE-IRRADIATED, POLYVINYLCHLORIDE, POLYETHYLENE-TER
EPHTHALATE, MYLAR, POLYTETRAFLUOROETHYLENE, TEFLON, POLYTRICHLOROVINYLCHLORIDE, KEL-F, POLYHEXAFLUOROPROPYL
ENE VITON A VINYLIDEN FLUORIDE, POLYDIMETHYLSILOXANE, FLUORINATED-SILOXANE, LS-53, BUTYL-RUBBER, IRON-OXIDE
S, TALC, ASBESTOS, ALUMINUM-CHIPS, STEEL-WOOL, MAGNESIUM-CHIPS, MAGNESIUM-SHEET, DYE-PENETRANTS, MAGNUGLO-PA
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RCO-DYE-CHECK PROCESS, ZYGLO-ZE-2-EMULSIFIER, ZYGLO-ZP-5-DEVELOPER, PROTECTIVE-COATINGS, DOW-CORNING-SILICON
E, PAINT-ON-GALBESTOS, DOW-CORNING-SILICONE-PAINT-XP-7-1003, GRIP-CLAD-PRIMER, SHERWIN-WILLIAMS-E41A4, SUPER
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OMPANY-GASKET MATERIAL, JOHNS-MANVILLE-76 GASKET MATERIAL, CLOTH-ASBESTOS, GLASS-COTTON-ALUMINIZED-MIL-C-824
0, COCOTITE-CERAMIC-INSULATION, CHROMATE-DYED-GLASS CLOTH, 3M-SAFETY-WALK-TYPE-B-M-0070, WALK-SYNTHETIC-CORK
, MASKING-TAPE, SHERLOCK-LEAK-DETECTOR-TYPE-0G, SHERLOCK-LEAK DETECTOR-WITH-15-PERCENT-METHANOL, SODIUM-NITR
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 990002150 LOUSHIN,L.L. LAMBERTIN,W.J. PALMER,A.J. ESSO APPLICATION OF FRACTURE-MECHANICS TO SAFE-LIFE DESIGN IN
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 990002180 HIMMELBERGER,F. APCI CHECK-LIST-AIR-SEPARATION-PLANT OPERATION APCI-SAFETY-STD-610.1/5 17P 2/16/61
 990002190 GRESS CHICAGO 7P PLUS 9P FIGURES PRESENTED BY W L BALL 10/19/59
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 990002210 LAPIN,A. APCI DISCUSSION WITH MR E LUCAS-IPD INSPECTION, REGARDING APCI CLEANLINESS REQUIREMENTS APCI
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990002770 BALL,W.L. APCI HOSE-CONNECTOR ACCIDENT- GRANITE/CITY FACILITY APCI-MEMO-67 12/15/67 1P
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 990003650 APL CONSTRUCTION SPECIFICATION FOR PIPING ERECTION, TESTING AND CLEANING APL-ENGR-SPEC-M-02 9P PLUS
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 990003690 ELMORE,G. APL SHELL AND TUBE-TYPE-COOLER, OTHER THAN FOR OXYGEN SERVICE (APL-PLANTS) APL-ENGR-SPEC-E-
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 990003740 PEGRAM,J.W. APL RELIEF VALVES, WARM GAS SERVICE -20F TO 100F APL-ENGR-SPEC-J-18 4P 6/18/69
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 990003800 PEGRAM,J.W. APL MINERAL WOOL APL-ENGR-SPEC-N-02 3P 1/2/70
 990003810 PEGRAM,J.W. APL INSULATION- PREFORMED CELLULAR GLASS SECTION FOR PIPELINES APL-ENGR-SPEC-N-05 5P 10
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 990003830 EVERSON,I. APL ACCIDENT AT AN OXYGEN CHARGING MANIFOLD APL-SAFETY-BULL-046 2P
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 990003850 EVERSON,I. APL MORE ACCIDENTS ON OXYGEN EQUIPMENT APL-SAFETY-BULL-102 1P 2/8/71
 990003860 EVERSON,I. LAMBA,J.S. APL BURCKHARDT OXYGEN COMPRESSOR FIRE AT SSPC ROGNAC PLANT 3/2/71 APL-SAFETY-
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 990003900 EVERSON,I. APL ACCIDENT AT T TURNER LTD PARK/LANE RUYTON OLDHAM LANCASTER 11 40 AM 5/2/70 APL-SA
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9900033940 CCULSON,K.J. CROXFORD,B.J. EVERSON,I. APL REPORT ON EXPLOSION OF CRYOSTAR-68.114-PUMP-NO-C.75 ON TANKE
R-400-11 2/17/71 AT THE CARRINGTON PLANT APL- SAFETY-DEPT-REP-35 7P PLUS APPENDIX I THROUGH VI 19P 3/
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9900033960 BRYANTON,M.C.W. BROWN,G.I. SHEPHERD,N. EVERSON,I. APL EXPLOSION ON OXY-FUEL-BURNER EQUIPMENT AT ALCAN
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EN SERVICE APL-QCP-Q12 REV.0 1P

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KS FOR OXYGEN SERVICE APL-QCP-Q13 REV.0 1P

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ENGR-STD-LS.30/2 3P 1/12/70

9900040060 APL PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 150PSIG (CSU.1.5) APL-ENGR-STD-LS.31/1
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TD-LS.31/2 6P 1/29/70

9900040080 APL PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 500PSIG (CSU5.0) APL-ENGR-STD-LS.31.3 6
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9900041010 CHAMBERS,J. APL LOX INSTALLATION AT CUSTOMER SITES APL-IGD-ENGR-MAN-40-01 7P 7/19/71

9900041020 GRAY,G. APL PROCEDURE FOR FILLING CRYOGENIC TANKER BY PUMP AT CARRINGTON APL-IGD-ENGR-MAN-50-01 3P
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9900041030 GRAY,G. APL PROCEDURE FOR FILLING CRYOGENIC TANKERS BY PUMP AT BRACKNELL APL-IGD-ENGR-MAN-50-02 3P
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9900042300 EVERSON,I. APL FIRE HAZARDS IN COMPRESSED-AIR AND OXYGEN RICH ENVIRONMENTS APL- SAFETY-DEPT-INFO-SHE
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9900042400 DENISON,D.M. RAF INSTITUTE OF AVIATION MEDICINE FARNBOROUGH HANTS ENGLAND ASSESSMENT OF THE FIRE R
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EN RICH GAS ENVIRONMENTS FPRC/MEMO-223 12P 7/65

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 APCI LUBRICANTS- HALOCARBON-11-21E, HALOCARBON PRODUCTS CORP APCI-IA1A-02 IP 2/21/72
 APCI LUBRICANTS- HALOCARBON-11-14E, HALOCARBON PRODUCTS CORP APCI-IA1A-03 IP 2/21/72
 APCI LUBRICANTS- HALOCARBON-6-25-WAX, HALOCARBON PRODUCTS CORP APCI-IA1A-04 IP 2/21/72
 APCI LUBRICANTS- KEL-F-90-GREASE, MINNESOTA MINING MANUFACTURING CO APCI-IA1A-05 IP 2/21/72
 APCI LUBRICANTS- HALOCARBON-25-55-GREASE, HALOCARBON PRODUCTS CORP APCI-IA1A-06 IP 2/21/72
 APCI LUBRICANTS- FLUOROLUBE, FS, HOOKER CHEMICAL APCI-IA1A-07 IP 2/21/72
 APCI LUBRICANTS- KRYTOX-143-AB-OIL DUPONT APCI-IA1A-08 IP 2/21/72
 APCI LUBRICANTS- KRYTOX-143-AC-OIL DUPONT APCI-IA1A-09 IP 2/21/72
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 APCI LUBRICANTS- FLUOROLUBE, FS-5, HOOKER CHEMICAL APCI-IA1A-11 IP 2/21/72
 APCI LUBRICANTS- MOLYLUBE-N BEL-RAY CU FARMINGDALE/NJ APCI-IA1A-12 IP 2/21/72
 APCI LUBRICANTS- MOLY-LUBE-NO-99, MOLY LUBE PRODUCTS GLEN/COVE/NY APCI-IA1A-13 IP 2/21/72
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 APCI LUBRICANTS- VOLTALUF-3A KINGSLEY AND KEITH LTD/UK APCI-IA1A-16 IP 2/21/72
 APCI LUBRICANTS- ESSO BEACON-325 APCI-IA1A-17 IP 2/21/72
 APCI LUBRICANTS- FORMBLIN-Y04 MONTECATINI-EDISON APCI-IA1A-18 IP 2/21/72
 APCI SEALANTS AND THREADING COMPOUNDS- PERMATEX-1516 APCI-IA2A-01 IP 2/21/72
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 APCI SEALANTS AND THREADING COMPOUNDS- T-FILM ECO MFGR CO APCI-IA2A-03 IP 2/21/72
 APCI SEALANTS AND THREADING COMPOUNDS- PUTTI-KOPE NATIONAL GREENHOUSE CO APCI-IA2A-04 IP 2/21/72
 APCI SEALANTS AND THREADING COMPOUNDS- MOLYLUBE-N BEL-RAY CU FARMINGDALE/NJ APCI-IA2A-05 IP 2/21/72
 APCI SEALANTS AND THREADING COMPOUNDS- CROSSLITE-FLUOROCARBON-TAPE APCI-IA2A-06 2P 2/21/72
 APCI SEALANTS AND THREADING COMPOUNDS- DAMCO TAPE APCI-IA2A-07 2P 2/21/72
 APCI SEALANTS AND THREADING COMPOUNDS- SANDEN TAPE APCI-IA2A-08 2P 2/21/72
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 APCI SEALANTS AND THREADING COMPOUNDS- OXOMAT APCI-IA2A-10 IP 2/21/72
 APCI SEALANTS AND THREADING COMPOUNDS- THREE-M FLUOROCARBON-TAPE APCI-IA2A-11 2P 2/21/72
 APCI SEALANTS AND THREADING COMPOUNDS- SODIUM-SILICATE AND CHINA-CLAY-PASTE APCI-IA2A-12 IP 2/21/72
 APCI THERMAL AND ELECTRICAL INSULATIONS- FOAMGLAS (CELLULAR-GLASS) INSULATION, PITTSBURGH-CORNING CORP APCI-IA3A-01 IP 2/21/72
 APCI THERMAL AND ELECTRICAL INSULATIONS- TRANSITE, JOHNS-MANVILLE APCI-IA3A-02 IP 2/21/72
 APCI THERMAL AND ELECTRICAL INSULATIONS- GLASS-WOOL APCI-IA3A-03 IP 2/21/72
 APCI THERMAL AND ELECTRICAL INSULATIONS- MINERAL-WOOL APCI-IA3A-04 IP 2/21/72
 APCI THERMAL AND ELECTRICAL INSULATIONS- PERLITE APCI-IA3A-05 IP 2/21/72
 APCI THERMAL AND ELECTRICAL INSULATIONS- MILFOAM MILFOAM CORP APCI-IA3A-06 IP 2/21/72
 APCI THERMAL AND ELECTRICAL INSULATIONS- NATIONAL-GYPSUM-BLUE NATIONAL-GYPSUM CORP APCI-IA3A-07 IP 2/21/72
 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- RTV-60, SILICONE-RUBBER COMPOUND WITH SS-4004-SILICONE-PRIMER G E THERMOLITE-12-CURING-CATALYST APCI-IA4A-01 IP 2/21/72
 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- KEENE-BINDER APCI-IA4A-02 IP 2/21/72
 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- KEL-F-81 APCI-IA4A-03 IP 2/21/72
 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- NYLON APCI-IA4A-04 IP 2/21/72
 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- NEOPRENE APCI-IA4A-05 IP 2/21/72
 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- VITON-A DUPONT APCI-IA4A-06 IP 2/21/72
 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- NYLON-66 ICI LTD/UK APCI-IA4A-07 IP 2/21/72
 APCI GASKETS AND PACKINGS- GRAPHITE-IMPREGNATED-ASBESTOS-PACKING APCI-IA5A-01 IP 2/21/72
 APCI GASKETS AND PACKINGS- TFE-GF-GREEN, MELRATH GASKETS CO APCI-IA5A-02 IP 2/21/72
 APCI GASKETS AND PACKINGS- VALLEGREEN, VALLEY/FORGE GASKET CO APCI-IA5A-03 IP 2/21/72
 APCI GASKETS AND PACKINGS- FLUOROGREEN-E-600, JOHN/DURE CU APCI-IA5A-04 IP 2/21/72
 APCI GASKETS AND PACKINGS- MELRATH-150 (SHEET-ASBESTOS GASKET MATERIAL) APCI-IA5A-05 IP 2/21/72
 APCI GASKETS AND PACKINGS- KM226-SHEET ASBESTOS GASKET MATERIAL NICOLET INDUSTRIES INC APCI-IA5A-06 IP 2/21/72
 APCI GASKETS AND PACKINGS- GARLOCK-900 (SHEET-ASBESTOS GASKET MATERIAL) GARLOCK MFG CO APCI-IA5A-07 IP 2/21/72
 APCI GASKETS AND PACKINGS- VULCANIZED-RED-FIBRE-GASKETS APCI-IA5A-08 IP 2/21/72
 APCI GASKETS AND PACKINGS- KM246 SHEET-ASBESTOS GASKET MATERIAL NICOLET INDUSTRIES APCI-IA5A-09 IP 2/21/72

990004820 APCI GASKETS AND PACKINGS- TEFLON, DUPONT APCI-IA5A-10 2P 2/21/72
 990004830 APCI GASKETS AND PACKINGS- VITON-A DUPONT APCI-IA5A-11 IP 2/21/72
 990004840 APCI GASKETS AND PACKINGS- SINDANYC CS-51-ASBESTOS AND CEMENT BOARDS. NATURAL-UNTREATED-FINISH TURNERS ASBESTOS CEMENT CO LTD/UK APCI-IA5A-12 IP 2/21/72
 990004850 APCI GASKETS AND PACKINGS- KLINGERIT-661 RICHARD KLINGER LTD/UK
 990004850 APCI-IA5A-13 IP 2/21/72
 990004860 APCI GASKETS AND PACKINGS- TYGAFLOL CEMENTABLE PTFE TAPES TYGADURE LTD/UK APCI-IA5A-14 IP 2/21/72
 990004870 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- TARSET PITTSBURGH CHEMICAL CO APCI-IA6A-01 IP 2/21/72
 990004880 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- SEALFAS-MASTIC-31-97 BENJAMIN FOSTER CO APCI-IA6A-02 IP 2/21/72
 990004890 APCI METALS, ALLOYS, SOLDERERS, AND SURFACE TREATMENTS- PLASITE-NO-7122H WISCONSIN PROTECTIVE COATING CO APCI-IA6A-03 IP 2/21/72
 990004900 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- COPPER-PIPE ASTM-B42 APCI-IA6A-04 IP 2/21/72
 990004910 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- COPPER-TUBE ASTM-B75 APCI-IA6A-05 IP 2/21/72
 990004920 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- RED-BRASS-PIPE ASTM-B43 APCI-IA6A-06 IP 2/21/72
 990004930 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B211-2024-T4 APCI-IA6A-07 2P 2/21/72
 990004940 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM, ASTM-B-210-3003 APCI-IA6A-08 2P 2/21/72
 990004950 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B209-5083-0 APCI-IA6A-09 2P 2/21/72
 990004960 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B210-6061-T6 APCI-IA6A-10 2P 2/21/72
 990004970 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B241-6061-T6 APCI-IA6A-11 2P 2/21/72
 990004980 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B247-6061-T6 APCI-IA6A-12 2P 2/21/72
 990004990 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM B361-WP6061-T6 APCI-IA6A-13 2P 2/21/72
 990005000 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- CARBUN STEEL (OXYGEN SERVICE) APCI-IA6A-14 3P 2/21/72
 990005010 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A312-TP304 APCI-IA6A-15 2P 2/21/72
 990005020 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A240-304 APCI-IA6A-16 2P 2/21/72
 990005030 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A403-WP304 AND A403-WP304L APCI-IA6A-17 2P 2/21/72
 990005040 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A320-B8304 APCI-IA6A-18 2P 2/21/72
 990005050 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A194-8T321 APCI-IA6A-19 2P 2/21/72
 990005060 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEELS-TYPE-416-CADMIUM-PLATED APCI-IA6A-20 IP 2/21/72
 990005070 APCI METALS, ALLOYS, SOLDERERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A182-F-304 AND ASTM-A182-F-316 APCI-IA6A-21 2P 2/21/72
 990005080 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL-TYPE-304 UNIDENTIFIED AS TO ASTM-S PEC APCI-IA6A-22 2P 2/21/72
 990005090 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- COPPER-SILICON ASTM-B98GRB APCI-IA6A-23 2P 2/21/72
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 990003100 SCHMOYER, W.W. APCI SNIFF THOSE CYLINDERS BEFORE REFILLING APCI-SAFETY-GRAM-NO-
 990002570 SCHMOYER, W.W. APCI SPECIALLY-GAS GAUGE-FAILURE APCI-MEMO-64 04/13/64 4P
 990000110 SCHMOYER, W.W. APCI VACUUM PUMP FAILURES APCI-SAFETY-GRAM-NO-35 1P 10/4/63
 990005080 SCHNYDER, R. APCI MASTER DRAWING 1200-SERIES REGULATIONS APCI-DRAWING-000-0-407
 990002240 SCOTT, D.J. APCI ANALYSES REQUIRED ON QUALITY-CONTROL-SAMPLES APCI-MEMO-68 05/
 990003960 SHEPHERD, N. EVERSON, I. APL EXPLOSION ON OXY-FUEL-BURNER EQUIPMENT AT ALCAN-800
 990002440 SMITH, H. APCI FIRE PROTECTION EQUIPMENT- OUTSIDE FIRE-HYDRANT APCI-SAFETY-STD
 990000470 SMITH, H. APCI PLANT COMPONENTS- AIR-SEPARATION PLANT, CRYOGENIC-LIQUID, AND DISP
 990000540 SMITH, H.W. APCI SOLVENT AND CLEANERS- DEVIATIONS CLEANING FOR OXYGEN SERVICE APCI
 990003160 SMITH, H.W. APCI PERSONNEL-PROTECTIVE-EQUIPMENT- EYE PROTECTION APCI-SAFETY-ST
 990003220 SMITH, H.W. APCI PERSONNEL-PROTECTIVE-EQUIPMENT- RESPIRATORY PROTECTIVE EQUIPME
 990002080 SMITH, H.W. APCI SAFETY CONTROL PROCEDURES- TAG OUT PROCEDURE APCI-SAFETY-STD-
 990002090 SMITH, H.W. APCI SAFETY CONTROL PROCEDURES- AIR-SEPARATION-PLANT SAFETY WORK P
 990003180 SMITH, H.W. APCI SAFETY EQUIPMENT NEVER PREVENTS AN ACCIDENT- IT ONLY PREVENTS
 990003370 STOLZ, J.L. APCI GENERAL SPECIFICATION FOR RECIPROCATING COMPRESSORS APCI-550-S
 990002680 STOMPLER, R.D. APCI LOX-PUMP SAFETY APCI-MEMO-71 2/19/71 1P
 990003270 STOMPLER, R.D. APCI LOX-PUMP SAFETY-BARRIERS APCI-MEMO-71 02/19/71 2P
 990002670 STOMPLER, R.D. APCI PAUL, CARTER, AND COSMODYNE LOX-PUMP SAFETY APCI-MEMO-71 1
 990002160 TAFURI, J.C. APCI ROBERTS, R. LEHIGH UNIV FATIGUE CRACK GROWTH-RATES AND FRACT
 990000580 TAYLOR, B.W. APCI USE OF PERLITE IN AIR-SEPARATION COLD-BOXES APCI-TB-39 1P 6
 990003490 THELSCH, H. GRINNELL CO DEFECTS AND FAILURES IN PRESSED-VESSELS AND PIPING REI
 990001540 THOMPSON, W.R. AEROMET-GENERAL CORP IGNITION CHARACTERISTICS OF METALS AND ALLOYS
 990000750 WALDE, R.A. APCI FLAMMABILITY AND EXPLOSION HAZARDS- PLANT-WASH-OUT STUDY CELLU
 990000760 WALDE, R.A. APCI FLAMMABILITY AND EXPLOSION HAZARDS- PLANT-WASH-OUT STUDIES CELLU
 990000740 WALDE, R.A. APCI FLAMMABILITY AND EXPLOSION HAZARDS- PLANT-WASH-OUT STUDIES CELLU
 990000750 WALDE, R.A. APCI FLAMMABILITY AND EXPLOSION HAZARDS- HALOCARBON, MOLYLUBE-99, MOL
 990000720 WALDE, R.A. APCI FLAMMABILITY AND EXPLOSION HAZARDS- KEL-F-POLYMER, NYLON, CUTTIN
 990001130 WALDE, R.A. APCI FLAMMABILITY AND EXPLOSION HAZARDS- OXYGEN-PRESSURE-GAUGE TWF THRE
 990001170 WALDE, R.A. APCI GASEOUS OXYGEN COMPATIBILITY OF CROSSLITE FLUOROCARBON TAPE THRE
 990001320 WALDE, R.A. APCI GASEOUS OXYGEN COMPATIBILITY TEST ON MOLY-LUBE-NO-99 APCI-MEMO
 990002010 WALDE, R.A. APCI RELATIONSHIP OF THE CHEMICAL STRUCTURE OF CUTTING OILS TO THEIR
 990001530 WARD, J.J. BATTELLE MEMORIAL INSTITUTE IGNITION OF METALS IN OXYGEN DMIC-REPO
 990002690 WEGENER, W. WINDGASSEN, K.F. FIRE TESTS ON CENTRIFUGAL PUMPS FOR LIQUID-OXYGEN C
 990001530 WHITE, E.L. BATTELLE MEMORIAL INSTITUTE IGNITION OF METALS IN OXYGEN
 990000450 WILSON, H. APCI PLANT COMPONENTS- COLD-BOXES APCI-SAFETY-STD-607.1.5 7P 1/63
 990002690 WRIGHT, G.T. DOMINION FOUNDRIES AND STEEL LTD OXYGEN PLANT VAPORIZER EXPLOSION
 990002970 YODER, L. APCI TAPE-SEAL THREAD LUBRICANT AND SEALER- TAPE-SEAL FROM FRIESLAND-
 990001590 YODER, L. APCI FLUORO-GLIDE FLAMMABILITY IN 100-PERCENT GASEOUS OXYGEN APCI-
 990001330 YODER, L. APCI NYLON-SEAT USED IN K-G REGULATOR- IGNITION-TEMPERATURE IN 100-PER
 990001300 YODER, L. APCI SEALING MATERIALS- FLAMMABILITY IN 100-PERCENT GASEOUS OXYGEN F
 990001140 YODER, L. APCI T-FILM THREAD COMPOUND, AUTOIGNITION TEST APCI-ANAL-REP-61-683
 990004210 ZURAWSKI, J. APL REPORT OF THE INVESTIGATION INTO BURCKHARDT CENTRIFUGAL PUMP EXP

BRUNN, G.I.

LYNTON, M.C.W.

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990004330 -GREASE, MINNESOTA MINING + MANUFACTURING CU APCI-IAIA-05 IP 2/21/72
 990001540 DEAN, L.E. THOMPSON, W.K. +AERJET-GENERAL CORP IGNITION CHARACTERISTICS OF METALS AND ALLOYS ARS JOURNAL
 99000261A KENDUS, J.J. +AIRCO DESCRIPTION OF AN AIR-SEPARATION PLANT EXPLOSION AICHE-CEP-TECH-MANUAL
 990002630 KENDUS, J.J. +AIRCO LIQUID OXYGEN PUMP FAILURES RE-99000301
 99000301C KENDUS, J.J. +AIRCO LIQUID OXYGEN PUMP FAILURES AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AM
 990003430 +AMERICAN PETROLEUM INST RECOMMENDED RULES FOR DESIGN AND CONSTRUCTION OF LARGE,
 990002100 +AMERICAN SOCIETY OF MECHANICAL ENGINEERS RULES FOR CONSTRUCTION OF PRESSURE V
 990002110 +AMERICAN SOCIETY OF MECHANICAL ENGINEERS QUALIFICATION STANDARD FOR WELDING A
 990003500 +AMERICAN SOCIETY OF MECHANICAL ENGINEERS GAS TRANSMISSION AND DISTRIBUTION P
 990003470 +AMERICAN SOCIETY OF MECHANICAL ENGINEERS PETROLEUM REFINERY PIPING ANSI-B31.5
 990003480 +AMERICAN SOCIETY OF MECHANICAL ENGINEERS REFRIGERATION PIPING ANSI-B31.5 60
 990002360 +AMERICAN STANDARDS ASSOC COMPRESSED GAS CYLINDER VALVE OUTLET AND INLET CONNEC
 990002720 +AMERICAN WELDING SOCIETY SAFETY IN WELDING AND CUTTING USAS-249.1 49P 1967
 990002900 +APCI 1200-SERIES REGULATOR- MATERIAL OF CONSTRUCTION 231-G-120054 (OXYGEN) DRAM
 990002550 +APCI ACCIDENT REPORTING APCI-POM-SEC-5.21 4P PLUS APPENDIX-A EXHIBIT-A 5/8/6
 990002540 +APCI ACCIDENT REPORTING APCI-CORP-ADMIN-PROC N-1.5 3P 4/1/68
 990005930 +APCI ACCIDENT-INCIDENT INVESTIGATION AND REPORT APL-SAFETY-BULLETTINS AND APL-SAF
 990005910 +APCI ACCIDENT/INCIDENT INVESTIGATION AND REPORT ACCIDENTS INVOLVING SPILLS AND
 990005920 +APCI ACCIDENT/INCIDENT INVESTIGATIONS AND REPORTS ACCIDENTS INVOLVING OXYGEN-EQU
 990000970 +APCI AIR-SEPARATION-PLANT CONTAMINATION- HISTORY, SAMPLING, AND ANALYSIS APCI
 990002240 +APCI ANALYSES REQUIRED ON QUALITY-CONTROL-SAMPLES APCI-MEMO-68 05/1/68 1P
 990002260 +APCI ANALYSES REQUIREMENTS SUMMARY APCI-DIST-OPER-MAN-V-1-SEC-6.32 7P 3/70
 990003580 +APCI ANALYSIS OF WATER-HAMMER IN CRYOGENIC TRANSFER-LINES BIBLIOGRAPHY APCI-RE
 990003190 +APCI AND THEN THERE WAS DARKNESS APCI-SAFETY-GRAM-NO-58 1P 3/15/67
 990000040 +APCI APPROVED ALLOY STEELS IN CRYOGENIC SERVICE APCI-SAFETY-GRAM-NO-10-REV-1 1
 990003290 +APCI ARE SAFETY-GLASSES WORTH THE COST AND EFFORT APCI-SAFETY-GRAM-NO-30 1P
 990001100 +APCI ASSEMBLY OF OXYGEN REGULATORS T-FILM APCI-MEMO-61 11/30/61 1P
 990002490 +APCI AUTO LOAD SYSTEMS APCI-MEMO-71 05/4/71 2P PLUS 3P ATTACHMENTS
 990001340 +APCI BEHAVIOR OF TRANSITE UNDER COMPRESSIVE-LOADS AT AMBIENT AND LIQUID-NITROGE
 990000870 +APCI BRAZED ALUMINUM HEAT-EXCHANGER CLEANING REQUIREMENTS APCI-QUAL-CONT-LAYOUT
 990005950 +APCI BURNING OF METALS IN OXYGEN ATMOSPHERES (80 TO 100-PERCENT) APCI-TM-186
 990001860 +APCI BURNING OF STEEL PIPES IN A FLOWING OXYGEN STREAM APCI-MEMO-61 04/17/61
 990002860 +APCI BYRON-JACKSON OXYGEN PUMP WASHOUT PROCEDURE FOR ANALYTICAL PURPOSES APCI
 990001060 +APCI CARBON-TETRACHLORIDE APCI-SAFETY-GRAM-NO-68 1P 2/21/69
 990000560 +APCI CAUTION- SNIFF TESTING CYLINDERS HAS ITS HAZARDS APCI-SAFETY-GRAM-NO-49 2
 990000520 +APCI CHECK-LIST- AIR-SEPARATION PLANT-SITE APCI-SAFETY-STD-610.1.1 5P 11/28/6
 990002180 +APCI CHECK-LIST-AIR-SEPARATION-PLANT OPERATION APCI-SAFETY-SIO-610.1/5 17P 2/
 990005260 +APCI CHEMICALS, SOLVENTS, AND MISC- 1,1,1 TRICHLOROETHANE APCI-IA7A-02 1P 2
 990005300 +APCI CHEMICALS, SOLVENTS, AND MISC- CHLOROFORM APCI-IA7A-03 1P 2/21/72
 990005290 +APCI CHEMICALS, SOLVENTS, AND MISC- TRICHLOROETHYLENE APCI-IA7A-05 1P 2/21/7
 990005280 +APCI CHEMICALS, SOLVENTS, AND MISC- CARBON-TETRACHLORIDE APCI-IA7A-04 1P 2/2
 990000250 +APCI CHEMICALS, SOLVENTS, AND MISC- 1,1 DICHLOROETHANE APCI-IA7A-01 1P 2/21/
 990000900 +APCI CIVIL-STRUCTURAL- PERSONNEL PROTECTIVE SHIELDS AND OXYGEN-SYSTEMS APCI-DES
 990000810 +APCI CLASS-A CLEANLINESS REQUIREMENTS APCI-QUAL-CONT-LAYOUT-105F 3P 7/1/71
 990000820 +APCI CLASS-AA CLEANLINESS REQUIREMENTS APCI-QUAL-CONT-LAYOUT-106F 3P 7/1/71
 990000830 +APCI CLASS-B CLEANLINESS REQUIREMENTS APCI-QUAL-CONT-LAYOUT-107F 3P 7/1/71
 990001010 +APCI CLEANING APCI-CONSTR-SPEC-230.15 UN P8 1P 9/16/69
 990000500 +APCI CLEANING AND INSPECTION FOR EQUIPMENT IN AIR PLANTS AND IN OXYGEN SERVICE
 990000950 +APCI CLEANING AND INSPECTION FOR EQUIPMENT IN AIR PLANTS AND IN OXYGEN SERVICE
 990000940 +APCI CLEANING FOR OXYGEN SERVICE APCI-MEMO-63 08/5/63 2P PLUS 9P ATTACHMENTS
 990000960 +APCI CLEANING FOR OXYGEN SERVICE 17P 1/60

KITSUN, F.K.
 KASSLER, E.J.

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| 990000900 | HATLEY, A.L. | +APCI | CLEANING LDX STORAGE TANK-NO-6 SANTA/SUSANA | APCI-MEMO-64 | 03/11/64 | IP | PLU |
| 990001020 | | +APCI | CLEANING OF CARBON STEEL PIPE AND FITTINGS, CLEANING ALUMINUM-PIPE FITTINGS | | | | |
| 990000780 | | +APCI | CLEANING REQUIREMENTS FOR BOURDON-TUBE TYPE GAUGES USED FOR OXYGEN SERVICE | | | | |
| 990000770 | | +APCI | CLEANING REQUIREMENTS FOR AIR-PLANT EQUIPMENT | APCI-QUAL-CONT-LAYOUT-101F | | | |
| 990005260 | | +APCI | CODED VESSEL REPAIRS | APCI-POM-SEC-6.09 | 4P | 15P | OF ATTCHMTS 11/29/68 |
| 990002040 | | +APCI | CODED VESSEL REPAIRS | APCI-POM-SEC-6.09 | 4P | 11/29/68 | FOR ATTCHMTS SEE 20 |
| 990001850 | FOSTER, R.H. | +APCI | COLD TEST OF 1/2-INCH SAFETY VALVE WITH CARBON STEEL SPRING | APCI-IMG-NU-1 | | | |
| 990002270 | | +APCI | COLD-BOX LEAKS | APCI-POM-SEC-1.14 | 5P | 10/30/68 | |
| 990001440 | BALL, W.L. | +APCI | COMBUSTIBLE CONTAMINANT CONTENT IN GRAPHITE IMPREGNATED ASBESTOS-PACKING TEF | | | | |
| 990000510 | SCHMOYER, W.W. | +APCI | COMPATIBILITY OF MATERIALS- OXYGEN COMPATIBLE MATERIALS | APCI-SAFETY-STD-60 | | | |
| 990003050 | LATSHAW, D.R. | +APCI | COMPATIBILITY OF MATERIAL WITH OXYGEN JOHNS-MANVILLE ASBESTOS SHEET PACKI | | | | |
| 990003380 | | +APCI | CONSTRUCTION SPECIFICATIONS GENERAL CONSTRUCTION AND EQUIPMENT ERECTION OX | | | | |
| 990000570 | GEIST, J.M. | +APCI | CONTROLLED KINETICS EXPERIMENTATION- TEFLOON-HOSE | APCI-MAR-87-0-8820 | IP | 5 | |
| 990000580 | GEIST, J.M. | +APCI | CONTROLLED KINETICS EXPERIMENTS- TEFLOON-HOSE | APCI-MAR-87-0-8820 | IP | 5 | |
| 990000430 | BALL, W.L. | +APCI | CRITERIA9 AIR-SEPARATION PLANT-LAYOUT | APCI-SAFETY-STD-605.1.3 | 6P | 1/6/61 | |
| 990006010 | | +APCI | CRYOGENIC SAFETY | APCI CRYOGENIC SAFETY CONFERENCE ALLENTOWN 145P | 7/5 | | |
| 990001070 | KEHAT, E. | +APCI | DEFONATION TESTS OF OIL FROM ALIQUIPPA PUMP-SUCTION FILTER DEFROST AND OF ME | | | | |
| 990001090 | KEHAT, E. | +APCI | DEVELOPMENT OF STANDARD IGNITION TEST | APCI-PROJECT-NO-87-0-8820/1 | 8P | 11/ | |
| 990001360 | KEHAT, E. | +APCI | DEVELOPMENT OF STANDARD IGNITION TEST METHYLENE-CHLORIDE- DICHLOROETHANE- TR | | | | |
| 990003000 | BALL, W.L. | +APCI | DISCUSSION OF ENERGY RELEASE IN A LIQUID OXYGEN PUMP | AICHE-CEP-TECH-MANUA | | | |
| 990002210 | LAPINA, A. | +APCI | DISCUSSION WITH MR E LUCAS-IPD INSPECTION, REGARDING APCI CLEANLINESS REQUI | | | | |
| 990000010 | KITSON, F.K. | +APCI | DUN_T TURN A CYLINDER INTO A ROCKET | APCI-SAFETY-GRAM-NO-04c | LP | 8/7/61 | |
| 990000030 | SCHMOYER, W.W. | +APCI | DRAIN-LINE EXPLOSION | APCI-SAFETY-GRAM-NO-24 | 2P | 1/17/63 | |
| 990000930 | | +APCI | EXCHANGER, PLANT, AND PLANT EQUIPMENT SOLVENT WASHOUT-FREQUENCIES | APCI-PO | | | |
| 990002380 | | +APCI | FILLING PROCEDURE FOR TRANSPORTABLE CRYOGENIC CONTAINERS | (250-GALLON CAPAC | | | |
| 990002390 | | +APCI | FILLING PROCEDURE FOR TRANSPORTABLE CRYOGENIC CONTAINERS | (250-GALLON CAPAC | | | |
| 990000020 | KITSON, F.K. | +APCI | FIRE IN OXYGEN-LINE | APCI-SAFETY-GRAM-NO-05 | IP | 10/20/61 | |
| 990002460 | | +APCI | FIRE PROTECTION EQUIPMENT- INSIDE- OUTSIDE | APCI-SAFETY-STD-630.3.2 | 3P | 5 | |
| 990002440 | SMITH, H. | +APCI | FIRE PROTECTION EQUIPMENT- OUTSIDE FIRE-HYDRANT | APCI-SAFETY-STD-630.2.2 | | | |
| 990002450 | | +APCI | FIRE PROTECTION EQUIPMENT- OUTSIDE HYDRANT-HOUSE AND EQUIPMENT | APCI-SAFET | | | |
| 990003320 | HUBBS, M.H. | +APCI | FIRE PROTECTION CGA AIR-SEPARATION PLANT SAFETY SYMPOSIUM | PP175-184 | | | |
| 990000550 | KITSON, F.K. | +APCI | FIRE PROTECTION EQUIPMENT- DELUGE-SYSTEM AND LOX LOADING FACILITY | APCI-SA | | | |
| 990000760 | WALDE, R.A. | +APCI | FLAMMABILITY AND EXPLOSION HAZARDS- HALUCARBON, MOLYLUBE-99, MOLYKOTE-TYPES- | | | | |
| 990000730 | WALDE, R.A. | +APCI | FLAMMABILITY AND EXPLOSION HAZARDS- HALUCARBON, MOLYLUBE-99, MOLYKOTE-TYPES- | | | | |
| 990000750 | WALDE, R.A. | +APCI | FLAMMABILITY AND EXPLOSION HAZARDS- PLANT-WASH-OUT STUDIES CELLULUBE-300 CEL | | | | |
| 990000720 | WALDE, R.A. | +APCI | FLAMMABILITY AND EXPLOSION HAZARDS- PLANT-WASH-OUT STUDIES CELLULUBE-300, DT | | | | |
| 990000740 | WALDE, R.A. | +APCI | FLAMMABILITY AND EXPLOSION HAZARDS- PLANT-WASH-OUT STUDIES CELLULUBE-300, DT | | | | |
| 990001460 | KITSON, F.K. | +APCI | FLAMMABILITY TEST OF GASKETS IN OXYGEN ATMOSPHERES JOHN-DURE-CO, MELRATH-G | | | | |
| 990002930 | SCHMAUCH, G.E. | +APCI | FLAMMABILITY TESTS ON INSULATION MATERIALS VASCOCEL MILFOAM NATIONAL-GYPSUM | | | | |
| 990001970 | | +APCI | FLEET SAFETY- FIRE EXTINGUISHMENT | APCI-SAFETY-STD-635.30 | 5P | 2/68 | |
| 990001940 | | +APCI | FLEET SAFETY- LOADING AND UNLOADING OPERATIONS | APCI-SAFETY-STD-635.19 | 6P | | |
| 990003110 | LATSHAW, D.R. | +APCI | FLUORESCENCE OF VARIOUS TYPES OF OILS- MOBIL-DTE-105 TEXACG-CAPPELLA-AA CELL | | | | |
| 990001390 | YODER, L. | +APCI | FLURO-GLIDE FLAMMABILITY IN 100-PERCENT GASEOUS OXYGEN | APCI-ANAL-REP-6 | | | |
| 990000070 | SCHMOYER, W.W. | +APCI | GASEOUS OXYGEN | APCI-SAFETY-GRAM-NO-23C | 6P | 1/10/63 | |
| 990001130 | WALDE, R.A. | +APCI | GASEOUS OXYGEN COMPATIBILITY OF CROSSLITE FLUROCARBON TAPE THREE-M-FLUROCA | | | | |
| 990001170 | WALDE, R.A. | +APCI | GASEOUS OXYGEN COMPATIBILITY TEST ON MOLY-LUBE-NU-99 | APCI-MEMO-63 | 06/11/6 | | |
| 990001410 | LATSHAW, D.R. | +APCI | GASKET MATERIAL COMPATIBILITY OF MELRATH MATERIAL WITH OXYGEN COMBUSTION IN | | | | |
| 990001420 | LATSHAW, D.R. | +APCI | GASKET MATERIALS COMPATIBILITY OF GASKET MATERIALS WITH OXYGEN COMBUSTION I | | | | |
| 990004790 | | +APCI | GASKETS AND PACKINGS- GARLOCK-900 (SHEET-ASBESTOS GASKET MATERIAL) GARLOCK | APCI-IA5A-01 | | | |
| 990004750 | | +APCI | GASKETS AND PACKINGS- GRAPHITE-IMPREGNATED-ASBESTOS-PACKING | APCI-IA5A-01 | | | |
| 990004780 | | +APCI | GASKETS AND PACKINGS- KM226-SHEET ASBESTOS GASKET MATERIAL NICOLET INDUSTR | | | | |
| 990004760 | | +APCI | GASKETS AND PACKINGS- FLUROGREEN-E-600, JOHN/DURE CO | APCI-IA5A-04 | IP | 2 | |
| 990004740 | | +APCI | GASKETS AND PACKINGS- TFE-GF-GREEN, MELRATH GASKETS | CU | APCI-IA5A-02 | IP | |

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| 990004800 | +APCI | GASKETS AND PACKINGS- | VULCANIZED-KED-FIBRE-GASKETS | APCI-IA5A-08 | IP | 2/21/72 |
| 990004770 | +APCI | GASKETS AND PACKINGS- | MELRATH-150 (SHEET-ASBESTOS GASKET MATERIAL) | APCI- | | |
| 990004750 | +APCI | GASKETS AND PACKINGS- | VALLEGREEN, VALLEY/FORGE GASKET CO | APCI-IA5A-03 | I | |
| 990004630 | +APCI | GASKETS AND PACKINGS- | VITON-A DUPONT | APCI-IA5A-11 | IP | 2/21/72 |
| 990004810 | +APCI | GASKETS AND PACKINGS- | KM246 SHEET-ASBESTOS GASKET MATERIAL NICOLET INDUSTR | | | |
| 990004860 | +APCI | GASKETS AND PACKINGS- | TYGAFLOK CEMENTABLE PIPE TAPES TYGADURE LTD/UK | A | | |
| 990004857 | +APCI | GASKETS AND PACKINGS- | KLINGERIT-661 RICHARD KLINGER LTD/UK | | | |
| 990004820 | +APCI | GASKETS AND PACKINGS- | TEFLON, DUPONT | APCI-IA5A-10 | 2P | 2/21/72 |
| 990004840 | +APCI | GASKETS AND PACKINGS- | SINDANYO CS-51-ASBESTOS AND CEMENT BOARDS, NATURAL-U | | | |
| 990003350 | +APCI | GENERAL SPECIFICATION FOR CLEANING FOR OXYGEN SERVICE | APCI-550-SD-27A | 5P | | |
| 990003360 | +APCI | GENERAL SPECIFICATION FOR CENTRIFUGAL COMPRESSORS | APCI-550-SD-16A | 37P | 4/ | |
| 990003370 | +APCI | GENERAL SPECIFICATION FOR RECIPROCATING COMPRESSORS | APCI-550-SD-01A | 37P | | |
| 990001380 | +APCI | HALOCARBON-WAX-6-25 | APCI-MEMO-69 | 02/6/69 | IP | |
| 990002190 | +APCI | HANDLING OF LOW-TEMPERATURE-FLUIDS AND HIGH-PRESSURE OXYGEN | NATIONAL SAFE | | | |
| 990002000 | +APCI | HAZARD LEVEL OF HYDROCARBON FILMS IN OXYGEN SYSTEMS | AICHE-CEP-TECH-MANUA | | | |
| 990001990 | +APCI | HAZARD LEVEL OF HYDROCARBON FILMS IN SYSTEMS CONTAINING LIQUID AND GASEOU | | | | |
| 990003030 | +APCI | HAZARD LEVEL OF HYDROCARBON FILMS IN SYSTEMS CONTAINING LIQUID AND GASEOU | | | | |
| 990001370 | +APCI | HIGH-PRESSURE OXYGEN COMPATABILITY TESTS WITH SILICONE-RUBBER GASKET COMPOUN | | | | |
| 990002770 | +APCI | HOSE-CONNECTOR ACCIDENT- GRANITE/CITY | APCI-MEMO-67 | 12/15/67 | IP | |
| 990000130 | +APCI | HUMAN TORCHES | APCI-SAFETY-GRAM-NO-50C | IP | 1/3/66 | |
| 990002060 | +APCI | HYDROSTATIC TESTING-GENERAL | APCI-QUAL-CONT-LAYOUT-117A | 2P | 7/1/71 | |
| 990001000 | +APCI | IGNITION TESTS OF T-FILM AND PENTON | APCI-MEMO-61 | 11/28/61 | 2P | |
| 990001880 | +APCI | IGNITION-LIMITS OF SOME STAINLESS STEELS IN AN OXYGEN-ATMOSPHERE | APCI-PRO | | | |
| 990001870 | +APCI | IGNITION-LIMITS OF CARBON STEEL IN OXYGEN-NITROGEN-ATMOSPHERES | APCI-IMD-NC | | | |
| 990002530 | +APCI | INDUSTRIAL SAFETY POLICY | APCI-PUM-SEC-5-16 | 7P | 10/30/68 | |
| 990002410 | +APCI | INDUSTRIAL SAFETY-INDUSTRIAL SAFETY POLICY | APCI-SAFETY-STD-625-0-1 | 13P | | |
| 990003250 | +APCI | INDUSTRIAL-SAFETY- OCCUPATIONAL NOISE | APCI-SAFETY-STD-625-0-1.2 | 3P | 4/9/77 | |
| 990002290 | +APCI | INSTRUMENTATION PREVENTIVE MAINTENANCE | APCI-PUM-SEC-6-05 | 5P | 10/30/68 | |
| 990000230 | +APCI | INSTRUMENTATION- ESTABLISHING PRESSURE-SETTINGS OF SAFETY DEVICES | APCI-DES | | | |
| 990002820 | +APCI | INSTRUMENTATION- MODIFICATION TO EXISTING PRESSURE-GAUGES SNUBBER | APCI-DES | | | |
| 990000220 | +APCI | INSTRUMENTATION- PRESSURE INDICATORS | APCI-DES-ENG-STD-531.2 | 5P | 10/63 | |
| 990000240 | +APCI | INSTRUMENTATION- SPECIAL REQUIREMENTS SAFETY AND RELIEF VALVES | APCI-DES-EN | | | |
| 990000400 | +APCI | INSULATION AND PAINTING- COLD-BOXES, THERMAL TANKS, GLASS WOOL | APCI-DES-EN | | | |
| 990000390 | +APCI | INSULATION AND PAINTING- COLD-INSULATION AND MINERAL FIBER GRANULATED | APCI | | | |
| 990002920 | +APCI | INSULATION AND PAINTING- COLD-BOXES THERMAL TANKS PERLITE | APCI-DES-ENG-STD | | | |
| 990001400 | +APCI | INSULATION MATERIALS FOR CRYOGENIC SYSTEMS MILFOAM URETHANE INSULATION NATI | | | | |
| 990000000 | +APCI | INVESTIGATION OF THE FIRE-RESISTANT QUALITIES OF CELLULUBE-220, CELLULUBE-15 | | | | |
| 990003420 | +APCI | ISOLATION OF PIPING-SYSTEMS | APCI-SAFETY-GRAM-NO-21 | IP | 10/29/62 | |
| 990001320 | +APCI | JOB SPECIFICATION 310000 GALLON CAPACITY LOX/LIN STORAGE TANK | APCI-JOB | | | |
| 990002480 | +APCI | KEL-F HIGH-PRESSURE OXYGEN COMPATIBILITY- NYLON | APCI-MEMO-63 | 05/17/63 | IP | |
| 990005940 | +APCI | LIATHROP AUTO-LOAD SYSTEM | APCI-MEMO-71 | 03/22/71 | 2P PLUS 3P ATTACHMENTS | |
| 990000170 | +APCI | LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA- ACCIDENT/INCIDENT INVESTIGAT | | | | |
| 990000030 | +APCI | LIQUID OXYGEN | APCI-SAFETY-GRAM-NO-06 | IP | 11/17/61 | |
| 990002650 | +APCI | LIQUID OXYGEN LOADING | APCI-SAFETY-GRAM-NO-54C | 6P | 1/31/67 | P6 REVISED 1/31/68 |
| 990002470 | +APCI | LIST OF CLEANING-AGENTS, ASSOCIATED EQUIPMENT AND SUPPLIES APPROVED FOR USE | | | | |
| 990003100 | +APCI | LOX AND LIN VAPOR DISPOSAL-TANK-500-GAL | APCI-DRAWING-92483D | REV-B | 9/30/66 | |
| 990000910 | +APCI | LOX COMPATIBLE GASKET MATERIALS GARLUCK-900 DURABLA JOHNS-MANVILLE ASBESTOS | | | | |
| 990002660 | +APCI | LOX TANKS | APCI-MEMO-70 | 06/26/70 | IP | |
| 990002650 | +APCI | LOX TRANSFER PUMP SCREENS | APCI-MEMO-69 | 01/24/69 | 2P PLUS 3P ATTACHMENTS | |
| 990002580 | +APCI | LOX TRANSFER PUMPS | APCI-MEMO-68 | 12/30/68 | 2P PLUS 2P ATTACHMENTS | |
| 990002680 | +APCI | LOX-PUMP FIRES AND EXPLOSIONS | APCI-MEMO-70 | 06/26/70 | 3P | |
| 990003270 | +APCI | LOX-PUMP SAFETY | APCI-MEMO-71 | 2/19/71 | IP | |
| 990002200 | +APCI | LOX-PUMP SAFETY-BARRIERS | APCI-MEMO-71 | 02/19/71 | 2P | |
| | +APCI | LOX-SPILL NCG CONSHOHUCKEN | APCI-MEMO-08 | 05/23/68 | 2P | |

990000090 +APCI LUBRICANTS AND THREAD COMPOUNDS FOR OXYGEN-SYSTEMS APCI-SAFETY-GRAM-NO-27
990004450 +APCI LUBRICANTS- ESSO BEACON-325 APCI-IA1A-17 1P 2/21/72
990004420 +APCI LUBRICANTS- FLUORO-GLIDE, CHEMPLAST INC APCI-IA1A-14 1P 2/21/72
990004390 +APCI LUBRICANTS- FLUOROLUBE, FS-5, HOOKER CHEMICAL APCI-IA1A-11 1P 2/21/72
990004350 +APCI LUBRICANTS- FLUOROLUBE, FS, HOOKER CHEMICAL APCI-IA1A-07 1P 2/21/72
990004460 +APCI LUBRICANTS- FORMBLIN-Y04 MONTECATINI-EDISON APCI-IA1A-18 1P 2/21/72
990004320 +APCI LUBRICANTS- HALOCARBON-6-25-WAX, HALOCARBON PRODUCTS CORP APCI-IA1A-04 1P
990004300 +APCI LUBRICANTS- HALOCARBON-11-21E, HALOCARBON PRODUCTS CORP APCI-IA1A-02 1P
990004340 +APCI LUBRICANTS- HALOCARBON-25-5S-GREASE, HALOCARBON PRODUCTS CORP APCI-IA1A-06
990004310 +APCI LUBRICANTS- HALOCARBON-11-14E, HALOCARBON PRODUCTS CORP APCI-IA1A-03 1P
990004330 +APCI LUBRICANTS- KEL-F-90-GREASE, MINNESOTA MINING MANUFACTURING CO APCI-IA
990004380 +APCI LUBRICANTS- KRYTOX-143-AZ-OIL DUPONT APCI-IA1A-10 1P 2/21/72
990004370 +APCI LUBRICANTS- KRYTOX-143-AC-OIL DUPONT APCI-IA1A-09 1P 2/21/72
990004290 +APCI LUBRICANTS- KRYTOX-143-AA-OIL DUPONT APCI-IA1A-01 1P 2/21/72
990004360 +APCI LUBRICANTS- KRYTOX-143-AB-OIL DUPONT APCI-IA1A-08 1P 2/21/72
990004430 +APCI LUBRICANTS- KRYTOX-143-AD-OIL DUPONT APCI-IA1A-15 1P 2/21/72
990004410 +APCI LUBRICANTS- MOLY-LUBE-NO-99, MOLY LUBE PRODUCTS GLEN/COVE/NY APCI-IA1A-1
990004400 +APCI LUBRICANTS- MOLYLUBE-N BEL-RAY CO FARMINGDALE/NJ APCI-IA1A-12 1P 2/21/
990004440 +APCI LUBRICANTS- VOLTALUF-3A KINGSLEY AND KEITH LTD/UK APCI-IA1A-16 1P 2/21/
990000270 +APCI MACHINERY- FIELD TESTING AND CENTRIFUGAL OXYGEN COMPRESSORS APCI-DES-ENG-S
990000260 +APCI MACHINERY- FIELD TESTING AND RECIPROCATING OXYGEN COMPRESSORS APCI-DES-ENG
990001930 +APCI MAINTENANCE AND INSPECTION REQUIREMENTS FOR BULK LIQUID CUSTOMER INSTALLATI
990001920 +APCI MAINTENANCE AND INSPECTION REQUIREMENTS FOR CUSTOMER BULK GAS SUPPLY SYSTEM
990005770 +APCI MAINTENANCE PROGRAM- SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW LEAKS
990005780 +APCI MAINTENANCE PROGRAM- SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW SYSTEM
990005830 +APCI MAINTENANCE PROGRAM PRESSURE TESTING APCI-IIIC-1 3P 9/12/71
990005790 +APCI MAINTENANCE PROGRAM- SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW INSULATI
990005760 +APCI MAINTENANCE PROGRAM SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW STRUCTURE
990005800 +APCI MAINTENANCE PROGRAM- SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW GENERAL
990005820 +APCI MAINTENANCE PROGRAM SAFE CLEANING PROCEDURES FOR FILTERS, TRAPS, AND INSTRU
990005810 +APCI MAINTENANCE PROGRAM- SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW PREVEN
990003310 +APCI MAINTENANCE OF PORTABLE FIRE-EXTINGUISHERS APCI-PUM-SEC-1.13 5P 3/30/67
990003080 SCHNYDER, R. +APCI MASTER DRAWING 1200-SERIES REGULATIONS APCI-DRAWING-000-0-407004E 1P 3/4
990005330 +APCI MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CON
990005320 +APCI MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, CLEANING-PR
990005350 +APCI MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CON
990005390 +APCI MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBIL
990005340 +APCI MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CON
990005370 +APCI MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBIL
990005310 +APCI MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, CLEANING-PR
990005380 +APCI MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBIL
990005400 +APCI MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBIL
990005360 +APCI MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBIL
990005110 +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- BERYLLIUM COPPER APCI-IA6
990005230 +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- MUNTZ-METAL 60-40-TYPE CO
990005170 +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS 9-PERCENT NICKEL
990005240 +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALPHA BRASS-TYPE TCL-100 OR
990005120 +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A269-3
990005200 +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- SHPEROIDAL-GRAPHITE IRON CO
990005150 +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- MONEL ASTM-B164 APCI-IA6A
990005210 +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- SILVER APCI-IA6A-35 1P
990005130 +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- BRUNZE ASTM-B61 OR B62 A
990005160 +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A351-G
990005220 +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- NOVONOX STAINLESS STEEL AL

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| 990005140 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | BRASS-SHEET OR PLATE ASTM- |
| 990005190 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | CARBON STEEL- NON-OXYGEN SE |
| 990005000 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | STAINLESS STEELS-TYPE-416-C |
| 990005080 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | STAINLESS STEEL-TYPE-304 UN |
| 990004890 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | PLASTIC-ND-7122H WISCONSIN |
| 990004950 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | ALUMINUM ASTM-B211-2024-T4 |
| 990005030 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | STAINLESS STEEL ASTM-A403-W |
| 990005050 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | STAINLESS STEEL ASTM-A194-B |
| 990004900 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | COPPER-PIPE ASTM-B42 APCI |
| 990004870 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | TAKSET PITTSBURGH CHEMICAL |
| 990004950 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | ALUMINUM ASTM-B209-5083-0 |
| 990005090 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | COPPER-SILICON ASTM-B98GRB |
| 990004980 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | ALUMINUM ASTM-B247-6061-T6 |
| 990004990 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | ALUMINUM B361-WP6061-T6 A |
| 990004970 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | ALUMINUM ASTM-B241-6061-T6 |
| 990005070 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | CARBON STEEL (OXYGEN SERVI |
| 990004880 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | STAINLESS STEEL ASTM-A182-F |
| 990005100 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | SEALFAS-MASTIC-31-97 BENJAM |
| 990005020 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | ALUMINUM ASTM-B210-6061-T6 |
| 990004920 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | FREE-MACHING BRASS APCI-1 |
| 990004910 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | STAINLESS STEEL ASTM-A240-3 |
| 990005010 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | RED-BRASS-PIPE ASTM-B43 A |
| 990005040 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | COPPER-TUBE ASTM-B75 APCI |
| 990005180 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | STAINLESS STEEL ASTM-A312-T |
| 990004940 | +APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- | STAINLESS STEEL ASTM-A320-B |
| 990003070 | +APCI MINUTES OF CGA AIR-SEPARATION EQUIPMENT COMMITTEE | COPPER-TUBE ASTM-B88 APC |
| 990002570 | +APCI MISTY PROBLEM VAPOR-CLOUDS FROM DEFROST OPERATIONS | ALUMINUM, ASTM-B-210-3003 |
| 990001230 | +APCI MOLLY-99 COMPATIBILITY TESTS WITH HIGH-PRESSURE OXYGEN | HELP AT FT/LAUDERDALE F |
| 990003400 | +APCI NASH VACUUM PUMPS APCI-MEMO-71 01/19/71 2P | ALLEGEDLY CAUSED HIGHWAY |
| 990002760 | +APCI NEAR-MISS ACCIDENT- GRANITE/CITY FACILITY APCI-MEMO-67 | APCI-R+D-NOTEBOOK-1 |
| 990002780 | +APCI NEAR-MISS ACCIDENT- BURNS/HARBOR APCI-MEMO-71 | 12/10/71 1P |
| 990002790 | +APCI NEAR-MISS ACCIDENT- GREIGHTON APCI-MEMO-68 | 02/8/71 2P |
| 990002810 | +APCI NOTES ON LIQUID OXYGEN CONTAMINANTS MISSILE-PROGRAM | 10P 1/6/58 |
| 990001080 | +APCI NYLON-SEAT USED IN K-G REGULATOR- IGNITION-TEMPERATURE IN | 100-PERCENT OXYGE |
| 990001330 | +APCI OPERATING AND SAFETY INSTRUCTION FOR REGULATORS AND COMPRESSED GASES | APCI |
| 990002880 | +APCI OPERATIONAL-HAZARDS- DISPOSAL OF VENTED GASES PROCEDURAL ARRANGEMENTS | APC |
| 990005480 | +APCI OPERATIONAL-HAZARDS- DISPOSAL OF VENTED GASES COMPANY PRACTICES | APCI-IIR- |
| 990005440 | +APCI OPERATIONAL-HAZARDS- COUPLING TO OTHER SYSTEMS | APCI-IIC1-1 APCI-IIC2-1 |
| 990005410 | +APCI OPERATIONAL-HAZARDS- OVERPRESSURE | APCI-IIA-1 2P 2/18/72 |
| 990005470 | +APCI OPERATIONAL-HAZARDS- DISPOSAL OF VENTED GASES CLEANLINESS OF | OXYGEN PIPING |
| 990005520 | +APCI OPERATIONAL-HAZARDS- SPILLS AND LEAKAGE SEPARATION OF INCOMPATIBLE MATERIALS | FABRICATED |
| 990005430 | +APCI OPERATIONAL-HAZARDS- OVERPRESSURE INTEGRITY OF INSULATION FIELD | APCI-IID-1 2P 9/3/71 |
| 990005450 | +APCI OPERATIONAL-HAZARDS- DISPOSAL OF VENTED GASES CLEANLINESS OF DISPOSAL | SYST |
| 990005500 | +APCI OPERATIONAL-HAZARDS- SPILLS AND LEAKAGE | APCI-IID-1 2P 9/3/71 |
| 990005420 | +APCI OPERATIONAL-HAZARDS- OVERPRESSURE INTEGRITY OF INSULATION SHOP | FABRICATED |
| 990005510 | +APCI OPERATIONAL-HAZARDS- SPILLS AND LEAKAGE DRAINAGE AND ULTIMATE DISPOSAL | ARRA |
| 990005530 | +APCI OPERATIONAL-HAZARDS- SPILLS AND LEAKAGE ENVIRONMENTAL | WARNINGS AND ESCAPE |
| 990005670 | +APCI OPERATIONAL-HAZARDS- OXYGEN-TRANSFER MALFUNCTION AND FAILURES | APCI-IIE3-1 |
| 990005630 | +APCI OPERATIONAL-HAZARDS- OXYGEN-TRANSFER ROAD RAILROAD | BARGE AND PIPELINE-TRA |
| 990005620 | +APCI OPERATIONAL-HAZARDS- OXYGEN-TRANSFER ROAD RAILROAD | BARGE AND PIPELINE-TRA |
| 990005580 | +APCI OPERATIONAL-HAZARDS- OXYGEN-TRANSFER SYSTEMS | SYSTEMS- FIELD FABRICATED CRY |

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|-----------|-----------------------------|-------|--|
| 990005660 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE-TRA |
| 990005750 | | +APCI | OPERATIONAL-HAZARDS- FIRES AND EXPLOSIONS APCI-IIG-1 6P 11/1/71 |
| 990005570 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER PRODUCTION, STORAGE TO SYSTEM, STORAGE |
| 990005680 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER MALFUNCTION AND FAILURES APCI INCIDENTS |
| 990005740 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES INSULATION S |
| 990005720 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES VALVES APC |
| 990005690 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER MALFUNCTIONS AND FAILURE INCIDENTS WHIC |
| 990005600 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER PIPELINE-TRANSPORTATION PIPELINE TRANS |
| 990005540 | | +APCI | OPERATIONAL-HAZARDS- SPILLS AND LEAKAGE DETECTION- QUANTITY AND RESPONSE TI |
| 990005650 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE-TRA |
| 990005700 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN TRANSFER EQUIPMENT MALFUNCTIONS AND FAILURES C |
| 990005640 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE TRA |
| 990005610 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER PIPELINE-TRANSPORTATION PIPELINE TRANS |
| 990005730 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES GEISERING, EX |
| 990005710 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER EQUIPMENT MALFUNCTIONS AND FAILURES G |
| 990005590 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER SYSTEMS SYSTEMS- APL OXYGEN-TRANSFER M |
| 990005550 | | +APCI | OPERATIONAL-HAZARDS- CONTAMINANTS ACUMULATION APCI-IIIE-1 1P 7/21/71 |
| 990005560 | | +APCI | OPERATIONAL-HAZARDS- OXYGEN-TRANSFER PRODUCTION TO STORAGE, STORAGE TO SYST |
| 990002310 | | +APCI | OPERATIONS DEPARTMENT PREVENTIVE MAINTENANCE REPORT FEED-BACK-CARD FORM-361 |
| 990003240 | MASTER, H.H. | +APCI | OPERATIONS HEARING PROTECTION PROGRAM APCI-MEMO-71 04/7/71 2P PLUS 1P |
| 990003300 | | +APCI | OPERATIONS SAFETY MANUAL APCI-SAFETY MANUAL-20P64 88P 1964 (OUT OF PR |
| 990001200 | BROPHY, M. | +APCI | OXYGEN COMPATABILITY TESTS- MOLYLUBE-KOTE-AR AND MOLYLUBE-N APCI-R+D-NOTE |
| 990001110 | DINAN, E. | +APCI | OXYGEN COMPATABILITY TESTS FOR VARIOUS MATERIALS- ABMA THREAD LUBRICANT AND |
| 990002600 | BALL, W.L. | +APCI | OXYGEN COMPRESSOR FIRE APCI-SAFETY-GRAM-NO-03 2P 7/7/61 |
| 990002430 | | +APCI | OXYGEN CONTROL-PANEL APCI-DES-ENG-STD-534.1 (TO BE PUBLISHED) |
| 990000050 | SCHMOYER, W.W. | +APCI | OXYGEN CYLINDER FAILURE APCI-SAFETY-GRAM-NO-13 2P 6/1/62 |
| 990002730 | MASTER, H.H. | +APCI | OXYGEN FLOW-METER RING SEAL-FLUID APCI-MEMO-70 02/27/70 1P |
| 990003120 | EDERICK, L.G. LATSHAW, D.R. | +APCI | OXYGEN COMPATABILITY WITH TWO-PART EPOXY-COMPOUND (7343-RESIN- 7139-CATAL |
| 990003000 | LAPIN, A. FOSTER, R.H. | +APCI | OXYGEN DIFFUSION IN THE ATMOSPHERE FROM LIQUID OXYGEN POOLS CGA AIR-S |
| 990005990 | LAPIN, A. FOSTER, R.H. | +APCI | OXYGEN DIFFUSION IN THE ATMOSPHERE FROM LIQUID OXYGEN POOLS ADVANCES I |
| 990003060 | EDERICK, L.G. LATSHAW, D.R. | +APCI | OXYGEN INDEX RATING SILICONE-O-RING (1/8-INCH DIA) APCI-IWO-NO-XD-0128 |
| 990003040 | EDERICK, L.G. LATSHAW, D.R. | +APCI | OXYGEN INDEX RATING VITON-O-RING MATERIAL- VITON-E-60 (GREEN) VITON-A (B |
| 990002640 | MASTER, H.H. | +APCI | OXYGEN PIPE-LINE FAILURE APCI-MEMO-67 12/29/67 1P |
| 990002340 | | +APCI | OXYGEN PUMP FILTER ASSEMBLY APCI-DRAWING-58521C REV-B 12/18/57 |
| 990000140 | SCHMOYER, W.W. | +APCI | OXYGEN REGULATORS IN THE WELDING INDUSTRY APCI-SAFETY-GRAM-NO-60C 5P 11/ |
| 990002170 | LATSHAW, D.R. | +APCI | OXYGEN SAFETY REVIEW CHECK-LIST APCI-MEMO-71 05/4/71 3P |
| 990003130 | EDERICK, L.G. LATSHAW, D.R. | +APCI | OXY-TITE THREAD COMPOUND APCI IWO-NO-XD-0134 APCI-ANAL-REP-71-336 1P 1 |
| 990002670 | STUMPLER, R.O. | +APCI | PAUL, CARTER, AND COSMODYNE LOX-PUMP SAFETY APCI-MEMO-71 1/01/26/71 2P |
| 990001040 | | +APCI | PERSONAL PROTECTION-EQUIPMENT MAINTENANCE APCI-PDM-1.12 7P 4/21/67 |
| 990003280 | | +APCI | PERSONNEL-PROTECTIVE SHIELDS FOR OXYGEN SYSTEMS APCI-TB-42 3P 9/30/71 |
| 990003160 | SMITH, H.W. | +APCI | PERSONNEL-PROTECTIVE-EQUIPMENT- EYE PROTECTION APCI-SAFETY-STD-627.4.2 5 |
| 990003200 | | +APCI | PERSONNEL-PROTECTIVE-EQUIPMENT- WEARING APPAREL HARD HATS APCI-SAFETY-ST |
| 990003230 | | +APCI | PERSONNEL-PROTECTIVE-EQUIPMENT- OCCUPATIONAL NOISE PROTECTIV |
| 990003330 | | +APCI | PERSONNEL-PROTECTIVE-EQUIPMENT ALUMINIZED HEAT PROTECTIVE CLOTHING APCI-S |
| 990003220 | SMITH, H.W. | +APCI | PERSONNEL-PROTECTIVE-EQUIPMENT- RESPIRATORY PROTECTIVE EQUIPMENT APCI-SA |
| 990003340 | | +APCI | PERSONNEL-PROTECTIVE-EQUIPMENT TONNAGE AIR-SEPARATION PLANT APCI-SAFETY-S |
| 990001480 | BROPHY, M. | +APCI | PIPE BURNING TESTS APCI-R+D-NOTEBOOK-111 P26-9 4P 4/17/61 |
| 990001180 | HIMMELBERGER, F. | +APCI | PIPING- APPROVED PIPE THREAD SEALANTS APCI-DES-ENG-STD-570.5.1 1P 11/11/ |
| 990000300 | | +APCI | PIPING- DRY OXYGEN SERVICE -20F TO 100F 150-PSIG-MAX CARBON-STEEL APC |
| 990000310 | | +APCI | PIPING- DRY OXYGEN SERVICE -20F TO 100F 275-PSIG-MAX CARBON-STEEL APC |
| 990000320 | | +APCI | PIPING- DRY OXYGEN SERVICE -20F TO 100F 500-PSIG-MAX-ONG CARBON-STEEL |
| 990000330 | | +APCI | PIPING- DRY OXYGEN SERVICE -20F TO 100F 720-PSIG-MAX CARBON-STEEL APC |
| 990000350 | | +APCI | PIPING- EXTENDED BONNET VALVE CODE APCI-DES-ENG-STD-579.4 3P 4/63 |
| 990001630 | | +APCI | PIPING- INTRODUCTION HAND VALVE-CODE APCI-DES-ENG-STD-579.3 12P 1/63 |

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| 990000290 | +APCI | PIPING-- OXYGEN COMPRESSOR LOCATION | APCI-DES-ENG-STD-570.6 | 2P | 1/15/71 |
| 990002560 | +APCI | PIPING-- OXYGEN COMPRESSOR SYSTEM | APCI-DES-ENG-STD-570.7 | | |
| 990000280 | +APCI | PIPING-- OXYGEN-PIPING | APCI-DES-ENG-STD-578.60.1 | 14P | 4/24/72 |
| 990001680 | +APCI | PIPING-- PRESSURE RATING TABLES- PLAIN-AND-THREADED-ENDS- | CARBON STEEL-PIPE | | |
| 990001740 | +APCI | PIPING-- PRESSURE RATING TABLES- PLAIN-AND-THREADED-ENDS- | STAINLESS STEEL-P | | |
| 990001610 | +APCI | PIPING-- PRESSURE RATING TABLES- PLAIN-ENDS COPPER-TUBE | APCI-DES-ENG-STD- | | |
| 990001510 | +APCI | PIPING-- PRESSURE RATING TABLES- PLAIN-AND-THREADED-ENDS- | RED BRASS-PIPE | | |
| 990001550 | +APCI | PIPING-- STAINLESS-STEEL VALVES AND MATERIAL REQUIREMENTS | ALUMINUM-PIPE | | |
| 990000340 | +APCI | PIPING-- TRANSITION-JOINTS AND ALUMINUM TO STAINLESS-STEEL | APCI-DES-ENG-STD- | | |
| 990000370 | +APCI | PIPING-- VALVE PROCUREMENT AND CLEANING PROCEDURE | APCI-DES-ENG-STD-579.5 | | |
| 990000360 | +APCI | PIPING-- AA1.5- COLD-BOX-SERVICE | 100F AND BELOW | 150-PSIG-MAX-OWG | ALUMINUM |
| 990001570 | +APCI | PIPING-- AA3- COLD-BOX-SERVICE | 100F AND BELOW | 300-PSIG-MAX-OWG | ALUMINUM |
| 990001580 | +APCI | PIPING-- AA.3- COLD-BOX-SERVICE | 150F AND BELOW | 30PSIG-MAX-OWG | ALUMINUM |
| 990001710 | +APCI | PIPING-- CS14- GENERAL-SERVICE | -20F TO 100F | 1440-PSIG-MAX-OWG | CARBON STEEL- |
| 990001840 | +APCI | PIPING-- CS1.5- GENERAL-SERVICE | -20F TO 100F | 150-PSIG-MAX-OWG | CARBON STEEL- |
| 990001720 | +APCI | PIPING-- CS20- GENERAL-SERVICE | -20F TO 100F | 2000-PSIG-MAX-OWG | CARBON STEEL- |
| 990001690 | +APCI | PIPING-- CS2.7- GENERAL-SERVICE | -20F TO 100F | 275-PSIG-MAX-OWG | CARBON STEEL |
| 990001730 | +APCI | PIPING-- CS36- GENERAL-SERVICE | -20F TO 100F | 3600-PSIG-MAX-OWG | CARBON STEEL |
| 990001700 | +APCI | PIPING-- CS7.2- GENERAL-SERVICE | -20F TO 100F | 720-PSIG-MAX-OWG | CARBON STEEL- |
| 990001620 | +APCI | PIPING-- CT2- COLD-BOX-SERVICE | 100F AND BELOW | 200-PSIG-MAX-OWG | COPPER-TUBE |
| 990001630 | +APCI | PIPING-- CT4- COLD-BOX-SERVICE | 100F AND BELOW | 400-PSIG-MAX-OWG | COPPER-TUBE |
| 990001590 | +APCI | PIPING-- IA4- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING | 100F AND BELOW | 400 | |
| 990001600 | +APCI | PIPING-- IA9- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING | 100F AND BELOW | 900 | |
| 990001660 | +APCI | PIPING-- ICT10- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING | 100F AND BELOW | -1 | |
| 990001670 | +APCI | PIPING-- ICT3- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING | 100F AND BELOW | 23 | |
| 990001640 | +APCI | PIPING-- ICT4- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING | 100F AND BELOW | 400 | |
| 990001650 | +APCI | PIPING-- ICT9- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING | 100F AND BELOW | 900 | |
| 990001770 | +APCI | PIPING-- SS12- COLD-BOX-SERVICE | 100F AND BELOW | 1235-PSIG-MAX-OWG | STAINLESS S |
| 990001660 | +APCI | PIPING-- SS17- COLD-BOX-SERVICE | 100F AND BELOW | 1715-PSIG-MAX-OWG | STAINLESS ST |
| 990001750 | +APCI | PIPING-- SS2.7- COLD-BOX-SERVICE | 100F AND BELOW | 275-PSIG-MAX-OWG | STAINLESS S |
| 990001790 | +APCI | PIPING-- SS30- COLD-BOX-SERVICE | 100F AND BELOW | 3000-PSIG-MAX-OWG | STAINLESS S |
| 990001800 | +APCI | PIPING-- SS36- COLD-BOX-SERVICE | 100F AND BELOW | 3600-PSIG-MAX-OWG | STAINLESS S |
| 990001760 | +APCI | PIPING-- SS6- COLD-BOX-SERVICE | 100F AND BELOW | 615-PSIG-MAX-OWG | STAINLESS STE |
| 990001810 | +APCI | PIPING-- SS7.2- COLD-BOX-SERVICE | 100F AND BELOW | 720-PSIG-MAX-OWG | STAINLESS S |
| 990001820 | +APCI | PIPING-- SSL1.5- LUBE-OIL-SERVICE | -20F TO 150F | 150-PSIG-MAX | STAINLESS STEEL |
| 990000460 | KITSON, F. | PLANT COMPONENTS- AIR-SEPARATION PLANT, PIPING, VALVES AND SAFETY-RELIEF DEV | | | |
| 990000470 | SMITH, H. | PLANT COMPONENTS- AIR-SEPARATION PLANT, PIPING, VALVES AND SAFETY-RELIEF DEV | | | |
| 990000440 | KITSON, F. K. | PLANT COMPONENTS- AIR-SEPARATION PLANT, PIPING, VALVES AND SAFETY-RELIEF DEV | | | |
| 990000450 | WILSON, H. | PLANT COMPONENTS- AIR-SEPARATION PLANT, PIPING, VALVES AND SAFETY-RELIEF DEV | | | |
| 990000490 | SCHMOYER, W. W. | PLANT COMPONENTS- AIR-SEPARATION PLANT, PIPING, VALVES AND SAFETY-RELIEF DEV | | | |
| 990000480 | BALL, W. L. | PLANT COMPONENTS- AIR-SEPARATION PLANT, PIPING, VALVES AND SAFETY-RELIEF DEV | | | |
| 990002320 | MASTEK, H. H. | PLANT PREVENTIVE MAINTENANCE-CONTROL | 9P PLUS EXHIBIT-A-1, A-2, A-3, A-4 | | |
| 990000990 | | PLANT SOLVENT WASHOUT-GENERAL | APCI-POM-SEC-1.05 | 12P | 2/20/67 |
| 990000420 | BALL, W. L. | PLANT-SITE CRITERIA- AIR-SEPARATION | APCI-SAFETY-STD-605.1 | 9P | 11/10/60 |
| 990001500 | BROPHY, M. | PLASITE PROTECTIVE COATING | APCI-MEMO-60 | 06/9/60 | 2P |
| 990004710 | | PLASTICS, ELASTOMERS, AND ADHESIVES- NYLON-A DUPONT | APCI-IA4A-06 | 1P | 2/21 |
| 990004690 | | PLASTICS, ELASTOMERS, AND ADHESIVES- VITON | APCI-IA4A-04 | 1P | 2/21/72 |
| 990004660 | | PLASTICS, ELASTOMERS, AND ADHESIVES- RTV-60, SILICONE-RUBBER COMPOUND WITH S | | | |
| 990004700 | | PLASTICS, ELASTOMERS, AND ADHESIVES- NEUPRENE | APCI-IA4A-05 | 1P | 2/21/72 |
| 990004680 | | PLASTICS, ELASTOMERS, AND ADHESIVES- KEL-F-81 | APCI-IA4A-03 | 1P | 2/21/72 |
| 990004720 | | PLASTICS, ELASTOMERS, AND ADHESIVES- NYLON-66 ICI LTD/UK | APCI-IA4A-07 | 1P | |
| 990004670 | | PLASTICS, ELASTOMERS, AND ADHESIVES- KEENE-6INDER | APCI-IA4A-02 | 1P | 2/21/7 |
| 990002070 | | PNEUMATIC TESTING-GENERAL | APCI-QUAL-CUNT-LAYOUT-105A | 3P | 7/1/71 |

| | | | | | | | |
|-----------|----------|------------------------|-------|--|------------------------------|----------|---------------------------|
| 990000120 | | SCHMOYER, W.W. | +APCI | PRESSURE GAUGE FAILURES | APCI-SAFETY-GRAM-NO-43 | 2P | 5/8/64 |
| 990003170 | | | +APCI | PRESSURE-GAUGE FAILURE SAFETY GLASSES SAVE ANOTHER PAIR OF EYES | APCI-SAFE | | |
| 990000160 | | | +APCI | PRESSURE-VESSELS- GASEOUS OXYGEN STORAGE CYLINDER | APCI-DES-ENG-STD-515.1.3 | | |
| 990000210 | | | +APCI | PRESSURE-VESSELS- HEAD-DESIGN | APCI-DES-ENG-STD-510.3 | 13P | 8/62 |
| 990000190 | | | +APCI | PRESSURE-VESSELS- MATERIALS OF CONSTRUCTION | APCI-DES-ENG-STD-510.1.4 | 4P | |
| 990000200 | | | +APCI | PRESSURE-VESSELS- SHELL-DESIGN | APCI-DES-ENG-STD-510.2 | 4P | 2/65 |
| 990000180 | | | +APCI | PRESSURE-VESSELS- VESSEL-DESIGN-BASIS AND GENERAL STANDARDS | APCI-DES-ENG-S | | |
| 990000150 | | | +APCI | PRESSURE-VESSELS- VAPORIZER AND CRYOGENIC LIQUID DISPOSAL | APCI-DES-ENG-STD | | |
| 990001310 | | | +APCI | PROCEDURE TO ESTABLISH ACCEPTANCE OF FIBERIZED MINERAL WOOL INSULATION | AP | | |
| 990002870 | | | +APCI | PRODUCT TEST PROCEDURES 1200-SERIES REGULATORS | APCI-TEST-PROCEDURE | 4P | 1/ |
| 990002510 | | MASTER, H.H. | +APCI | PRODUCT VAPOR HAZARDS- SAFETY INFORMATION RELATIVE TO LIQUID-VAPOR-CLOUDS | | | |
| 990001470 | | BASSLER, E. | +APCI | PRODUCTION OF ROCK WOOL BETHLEHEM-STEEL-CO | APCI-MEMO-59 | 11/12/59 | 2P |
| 990001120 | | ENT, W.L. | +APCI | PUTTI-ROPE ANALYSIS FOR OIL CONTENT AND FLAMMABILITY TEMPERATURE | APCI-ME | | |
| 990002230 | | | +APCI | QUALITY CONTROL PROGRAM | APCI-DIST-OPER-MAN-6.3 | 6P | 7/65 1/69 4/68 PLU |
| 990001450 | | HIMMELBERGER, F. | +APCI | QUALITY CONTROL OF ROCK WOOL | APCI-MEMO 2 HIMMELBERGER, F. | | APCI QUALITY |
| 990001450 | I-MEMO 2 | HIMMELBERGER, F. | +APCI | QUALITY CONTROL OF ROCK WOOL | APCI-MEMO-59 | 11/6/59 | 2P |
| 990001190 | | SCHMOYER, W.W. | +APCI | REGULATOR THREAD SEALANT MOLYLUBE-N | APCI-MEMO-63 | 10/4/63 | 1P |
| 990002010 | | WALDE, R.A. | +APCI | RELATIONSHIP OF THE CHEMICAL STRUCTURE OF CUTTING OILS TO THEIR OXYGEN-COMPA | | | |
| 990002610 | | BALL, W.L. | +APCI | REPORT OF OXYGEN PUMP EXPLOSION AIRCO-BUTLER | APCI-MEMO-63 | 10/21/63 | 1P 1P |
| 990000880 | | | +APCI | REQUIREMENTS FOR IPD SPECIFIED PAINT SYSTEMS | APCI-QUAL-CONT-LAYOUT-120F | | |
| 990000830 | | | +APCI | REQUIREMENTS FOR VENDOR CLASS-B CLEANING | APCI-QUAL-CONT-LAYOUT-114F | 2P | 7 |
| 990000860 | | | +APCI | REQUIREMENTS FOR VENDOR CLASS-AA CLEANING | APCI-QUAL-CONT-LAYOUT-117F | 3P | |
| 990000850 | | | +APCI | REQUIREMENTS FOR VENDOR CLASS-AA CLEANING | APCI-QUAL-CONT-LAYOUT-116F | 2P | |
| 990000840 | | | +APCI | REQUIREMENTS FOR VENDOR CLASS-A CLEANING | APCI-QUAL-CONT-LAYOUT-115F | 2P | 7 |
| 990002250 | | ENT, W.L. | +APCI | REVISIONS TO IGD QUALITY ASSURANCE PROGRAM COST-PROCEDURES DIST-OPER-MAN-V | | | |
| 990003140 | | KITSON, F.K. | +APCI | RUPTURE DISCS MANUFACTURED LOX TANKERS BY AMETEK | APCI-MEMO-71 | 06/22/71 | |
| 990002830 | | | +APCI | SAFE HANDLING OF CRYOGENIC LIQUIDS AND ASSOCIATED EQUIPMENT | APCI-POM-SEC- | | |
| 990002700 | | SCHMOYER, W.W. | +APCI | SAFE HANDLING OF REGULATORS AND TORCHES | APCI-PAPER 17P PLUS | 2P | ATTACHME |
| 990003180 | | SMITH, H.W. | +APCI | SAFETY EQUIPMENT NEVER PREVENTS AN ACCIDENT- IT ONLY PREVENTS AN INJURY | | | |
| 990000530 | | | +APCI | SAFETY CONTROL PROCEDURES- EMERGENCY PROCEDURES | APCI-SAFETY-STD-626.3.8 | | |
| 990002400 | | | +APCI | SAFETY CONTROL PROCEDURES-PURGING METHODS | APCI-SAFETY-STD-626.4.1 | 7P | 1/ |
| 990002090 | | SMITH, H.W. | +APCI | SAFETY CONTROL PROCEDURES- AIR-SEPARATION-PLANT SAFETY WORK PERMITS | APC | | |
| 990002080 | | SMITH, H.W. | +APCI | SAFETY CONTROL PROCEDURES- TAG OUT PROCEDURE | APCI-SAFETY-STD-626.3.3 | 2P | |
| 990002030 | | | +APCI | SAFETY CONTROL PROCEDURE- SAFETY WORK-PERMIT | APCI-POM-SEC-1.04 | 3P | PLUS |
| 990002020 | | | +APCI | SAFETY CONTROL PROCEDURE- TAG OUT | APCI-POM-SEC-1.03 | 2P | PLUS EXHIBIT-A |
| 990003460 | | | +APCI | SAFETY RELIEF VALVES LOCATION AND PIPING-DESIGN CONSIDERATIONS | APCI PIPIN | | |
| 990002330 | | | +APCI | SAFETY REPORTS AND FORMS | APCI-POM-SEC-5.18 | 6P | PLUS EXHIBITS ABCDEFGH 3/ |
| 990001350 | | BRUPHY, M. | +APCI | SAFETY TESTS UNDER WO-81-0095 HYLOMAR-UNIVERSAL-JOINTING COMPOUND SQ-32 AND | | | |
| 990001210 | | MOYSAN, S.R. | +APCI | SAFETY-VALVE-SEAT OXOMAT FLAMMABILITY IN 100-PERCENT GASEOUS OXYGEN | APCI | | |
| 990002300 | | | +APCI | SAFETY-VALVES AND RUPTURE-DISCS | APCI-POM-SEC-6.02 | 19P | INCLUDING EXHIBITS |
| 990000590 | | KEHAT, E. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- UCON-TYPE LUBRICANTS, STEEL-PIPES | | | |
| 990000600 | | KEHAT, E. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- STANDARD PRESSURE BOMBS AND SPARK-IG | | | |
| 990000690 | | FOSTER, R.H. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- HOUDRY FOAM INSULATION, AND HAVEG GL | | | |
| 990000680 | | FOSTER, R.H. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- IGNITION TEST-APPARATUS, FLORUBE-GRE | | | |
| 990000670 | | FOSTER, R.H. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- POLYESTER RESIN IMPREGNATED FIBERGL | | | |
| 990000700 | | FOSTER, R.H. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- TALCUM-POWDER AS A LUBRICANT, TARSET | | | |
| 990000640 | | KEHAT, E. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- CS2 CARBON-DISULFIDE ALIQUIPPA PUMP- | | | |
| 990000620 | | KEHAT, E. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- PINE AND MAPLE WOOD, ACTIVATED CARBO | | | |
| 990000630 | | KEHAT, E. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- SILICON-OILS DOW-CORNING-RF-1-0065, | | | |
| 990000610 | | KEHAT, E. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- SPARK-IGNITION, STANDARD BOMB TEST, | | | |
| 990000580 | | FOSTER, R.H. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- EPON-H-60, POLYCEL-440R, AND STYROFO | | | |
| 990000650 | | KEHAT, E. FOSTER, R.H. | +APCI | SAFETY, HAZARDS, AND EXPLOSION TESTING- STANDARD IGNITION TEST METHOD, APL P | | | |
| 990004560 | | | +APCI | SEALANTS AND THREADING COMPOUNDS- OXOMAT | APCI-142A-10 | 1P | 2/21/72 |
| 990004510 | | | +APCI | SEALANTS AND THREADING COMPOUNDS- MOLYLUBE-N BEL-KAY CO FARMINGDALE/NJ | | | A |

990004530 +APCI SEALANTS AND THREADING COMPOUNDS- DAMCO TAPE APCI-IA2A-07 2P 2/21/72
 990004530 +APCI SEALANTS AND THREADING COMPOUNDS- CKANE PACKING CO-TAPE APCI-IA2A-09 2P
 990004490 +APCI SEALANTS AND THREADING COMPOUNDS- I-FILM ECO MFRG CO APCI-IA2A-03 1P 2
 990004540 +APCI SEALANTS AND THREADING COMPOUNDS- SANDEN TAPE APCI-IA2A-08 2P 2/21/72
 990004500 +APCI SEALANTS AND THREADING COMPOUNDS- PUTTI-ROPE NATIONAL GREENHOUSE CO APCI
 990004570 +APCI SEALANTS AND THREADING COMPOUNDS- THREE-M FLUOROCARBON-TAPE APCI-IA2A-11
 990004480 +APCI SEALANTS AND THREADING COMPOUNDS- TEFLON-TAPE PERHACEL APCI-IA2A-02 2P 2
 990004580 +APCI SEALANTS AND THREADING COMPOUNDS- SODIUM-SILICATE AND CHINA-CLAY-PASTE APCI
 990004470 +APCI SEALANTS AND THREADING COMPOUNDS- PERMATEX-1516 APCI-IA2A-01 1P 2/21/72
 990004520 +APCI SEALANTS AND THREADING COMPOUNDS- CROSSLITE-FLUOROCARBON-TAPE APCI-IA2A-06
 990001300 +APCI SEALING MATERIALS- FLAMMABILITY IN 100-PERCENT CASEOUS OXYGEN FOAMSEAL-30
 990002890 +APCI SET-UP AND OPERATING INSTRUCTIONS FOR AIR-PRODUCTS REDI-SET WELDING AND CUTT
 990000100 +APCI SNIFF THOSE CYLINDERS BEFORE REFILLING APCI-SAFETY-GRAM-NO-31 2P 8/21/63
 990002570 +APCI SOLVENT AND CLEANERS- DEVIATIONS CLEANING FOR OXYGEN SERVICE APCI-SAFETY-S
 990000540 +APCI SPECIALTY-GAS GAUGE-FAILURE APCI-MEMO-64 04/13/64 4P
 990003260 +APCI STAFFING AND CHECK-IN SYSTEMS FOR OPERATING-PLANTS APCI-MEMO-68 06/25/
 990003410 +APCI STANDARD SPECIFICATION FOR A FIELD-FABRICATED CRYOGENIC LIQUID STORAGE-TANK
 990000890 +APCI STORAGE TANK CLEANING APCI-MEMO-63 01/24/73 1P
 990000890 +APCI SUMMARY OF ACTION TAKEN ON PRESSURE-GAUGES APCI-MEMO-61 08/2/61 4P
 990005850 +APCI SYSTEM-EMERGENCIES PROTECTION BUILDINGS AND ADJACENT SYSTEMS PROTECTION
 990005840 +APCI SYSTEM-EMERGENCIES WARNING DEVICES APCI-IV8-1 5P 11/12/71
 990005850 +APCI SYSTEM-EMERGENCIES HAZARDS PROTECTION GENERAL PRECAUTIONS APCI-IVE-1 2P
 990005900 +APCI SYSTEM-EMERGENCIES APCI-IV-1 1P 12/23/71
 990001160 +APCI SYSTEM-EMERGENCIES SAFETY TRAINING AND AREA PLACARDING APCI-IVA-1 4P
 990001490 +APCI SYSTEM-EMERGENCIES PROTECTION PERSONNEL APCI-IVCI-1 6P 1/13/72
 990001150 +APCI SYSTEM-EMERGENCIES HAZARDS PROTECTION APL-BULLETINS AND REPORTS ON VARIOUS
 990002220 +APCI TAPE-SEAL THREAD LUBRICANT AND SEALER- TAPE-SEAL FROM FRIESLAND-PLASTIC COM
 990002840 +APCI TARGET PIPE-COATING THE PLASTE TESTS MANUFACTURED BY PITTSBURGH CHEMICAL
 990002910 +APCI TEFLON TAPE PERCENT ETHER EXTRACTABLE CONTAMINANTS AND FLUORESCENCE DAMCO-TE
 990002740 +APCI TELEPHONE CONVERSATION WITH MR WILLIAM MCCORMICK REGARDING REQUIREMENTS FO
 990004620 +APCI TESTING OF SCREENS TO BE USED IN OXYGEN COMPRESSOR SUCTION APCI-MEMO-71
 990004600 +APCI TESTS OF PRESSURE-GAGES SAFETY DEVICES APCI-PROJECT-NO-87-0-8820 APCI-ME
 990004590 +APCI THERMAL AND ELECTRICAL INSULATIONS- PERLITE APCI-IA3A-05 1P 2/21/72
 990004610 +APCI THERMAL AND ELECTRICAL INSULATIONS- FOAMGLAS (CELLULAR-GLASS) INSULATION,
 990004650 +APCI THERMAL AND ELECTRICAL INSULATIONS- GLASS-WOOL APCI-IA3A-03 1P 2/21/72
 990001140 +APCI THERMAL AND ELECTRICAL INSULATIONS- NATIONAL-GYPSUM-BLUE NATIONAL-GYPSUM CO
 990000380 +APCI T-FILM THREAD COMPOUND, AUTOIGNITION TEST APCI-ANAL-REP-61-683 APCI-IWO-
 990000380 +APCI USE OF PERLITE IN AIR-SEPARATION COLD-BOXES APCI-IB-39 1P 6/14/71
 990000110 +APCI VACUUM PUMP FAILURES APCI-SAFETY-GRAM-NO-35 1P 10/4/63
 990001430 +APCI VALVE WASHERS NEW AND USED QUALITATIVE AND QUANTITATIVE OIL ANALYSIS APCI
 990000920 +APCI WASHOUT ANALYSIS OF SUN-OIL COMPANY'S LOX-TANK VAPORIZER APCI-MEMO-64 04
 990003210 +APCI WEAK SAFETY SHOES APCI-SAFETY-GRAM-NO-11 2P 5/14/62
 990003950 +APCI EVERSON, J. GRIFFITHS, D.K. APL RECOMMENDATIONS ARISING FROM EXPLOSION OF C
 990002160 +APCI ROBERTS, R. LEHIGH UNIV FATIGUE CRACK GROWTH-RATES AND FRACTURE TOUGHNESS
 990003600 +APCI ACCEPTANCE TEST FOR CLASS-B CLEANLINESS (OXYGEN-CLEAN) APL-ENGR-SPEC-A.03
 990003620 +APCI ACCEPTANCE TEST FOR CLASS-AA CLEANLINESS (OXYGEN-CLEAN) APL-ENGR-SPEC-A.02 3P 5/12/69
 990003610 +APCI EVERSON, J. APL ACCIDENT ARISING FROM VENTING-OXYGEN MANIFOLDS CONNECTED TO A COMMON VENT P
 990003840 +APCI EVERSON, J. APL ACCIDENT AT AN OXYGEN CHARGING MANIFOLD APL-SAFETY-BULL-046 2P
 990003830 +APCI EVERSON, J. APL ACCIDENT AT T TURNER LTD PARK/LANE ROYTON OLDHAM LANCASTER 11940 AM 5/2
 990003900 +APCI EVERSON, J. APL ACCIDENT AT T TURNER LTD PARK/LANE ROYTON OLDHAM LANCASTER 11940 AM 5/2

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|-----------|-----------------------------|------|---|
| 990004030 | | +APL | ALOCLENE-100 AND APPLIED CHEMICALS-5.57 1P 2/5/72 |
| 990003080 | PEGRAM, J.W. | +APL | BRAZED CORE EXTENDED SURFACE HEAT-EXCHANGERS APL-ENGR-SPEC-E.02 9P 6/28/7 |
| 990003850 | EVERSON, I. LANBA, J.S. | +APL | BURCKHARDT OXYGEN COMPRESSOR FIRE AT SSPC ROGNAC PLANT 3/2/71 APL-SAFETY- |
| 990003710 | OLIVER, R. | +APL | CENTRIFUGAL CRYOGENIC PUMPS APL-ENGR-SPEC-G.03 14P 4/1/71 |
| 990004100 | | +APL | CENTRIFUGAL OXYGEN COMPRESSOR MANUAL HATTINGEN PLANT 15P APPENDIX I II II |
| 990003650 | | +APL | CONSTRUCTION SPECIFICATION FOR PIPING ERECTION, TESTING AND CLEANING APL-E |
| 990003970 | | +APL | CONSTRUCTION SPECIFICATION FOR PIPING ERECTION, TESTING AND CLEANING APL-E |
| 990003780 | PEGRAM, J.W. | +APL | CRYOGENIC LIQUID HOSE-COUPPLINGS FOR USE IN THE U.K. APL-ENGR-STD-LS.08 6P |
| 990003030 | PEGRAM, J.W. | +APL | DEGREASING ACCEPTANCE TESTS FOR OXYGEN SERVICE COMPRESSORS APL-ENGR-SPEC-K |
| 990004050 | PEGRAM, J.W. | +APL | DESIGN AND SAFETY SATNDARDS FOR CARBON-STEEL GASEOUS OXYGEN TRANSMISSION-L |
| 990003790 | PEGRAM, J.W. | +APL | EXPANDED PERLITE APL-ENGR-SPEC-N.01 3P 1/2/70 |
| 990004190 | | +APL | EXPERIMENTS WITH LIQUID OXYGEN APL-SAFETY-BULL-025 1P REPRINTED 1/68 |
| 990003920 | EVERSON, I. | +APL | EXPLOSION AND FIRE DUE TO THE CRYOSTAR-G8114 LOX-PUMP ON AN SSPC LOX-TANKER |
| 990003960 | SHEPHERD, N. EVERSON, I. | +APL | EXPLOSION ON OXY-FUEL-BURNER EQUIPMENT AT ALCAN-BOOTH ALUMINIUM WORKS ROGER |
| 990003870 | GILLOTT, E. EVERSON, I. | +APL | FAILURE OF BRAZED JOINTS IN HIGH-PRESSURE GASEOUS OXYGEN-LINE AT A CYLINDER |
| 990001050 | COULSON, K.J. EVERSON, I. | +APL | FIRE HAZARD WHEN VAPOUR CLEANING WITH TRICHLOROETHYLENE (T.C.E.) APL-SAFET |
| 990003820 | | +APL | FIRE IN OXYGEN-LINE APL-SAFETY-BULL-028 1P 1/68 |
| 990004230 | EVERSON, I. | +APL | FIRE HAZARDS IN COMPRESSED-AIR AND OXYGEN RICH ENVIRONMENTS APL-SAFETY-D |
| 990003760 | PEGRAM, J.W. | +APL | FLEXIBLE HOSES FOR CHARGING AND DISCHARGING MANIFOLDS OXYGEN SERVICE APL |
| 990003990 | | +APL | GENERAL PROCEDURE FOR DECONTAMINATION OF STATIC-TANK AND ROAD-VEHICLE-ASSEMBL |
| 990004270 | EVERSON, I. | +APL | HAZARD LEVEL OF HYDROCARBON FILMS IN OXYGEN SYSTEMS APL-SAFETY-DEPT-INFO- |
| 990003810 | PEGRAM, J.W. | +APL | INSULATION- PREFORMED CELLULAR GLASS SECTION FOR PIPELINES APL-ENGR-SPEC-N |
| 990003930 | EVERSON, I. | +APL | INVESTIGATION OF CRYOSTAR LOX-PUMP EXPLOSION AT STOKES PLANT 8/7/70 APL-SA |
| 990003910 | EVERSON, I. | +APL | INVESTIGATION OF VALVE FIRES AT TEXAS INSTRUMENTS LTD-BEDFORD APL-SAFETY- |
| 990004200 | | +APL | LACK OF OXYGEN KILLS TWO WORKMEN APL-SAFETY-BULL-037 1P REPRINTED 1/68 |
| 990004280 | EVERSON, I. | +APL | LIMITING VALUES OF OIL-CONTAMINATION OF STAINLESS-STEEL SURFACES EXPOSED TO |
| 990004110 | CHAMBERS, J. | +APL | LOX INSTALLATION AT CUSTOMER SITES APL-IGD-ENGR-MAN-40-01 7P 7/19/71 |
| 990004000 | | +APL | MANUFACTURING QUALITY PROCEDURE FOR DEGREASING OF PIPEWORK APL-QCP-Q11 REV |
| 990004010 | | +APL | MANUFACTURING QUALITY PROCEDURE FOR INTERNAL CLEANING OF ALUMINUM TANKERS AN |
| 990004020 | | +APL | MANUFACTURING QUALITY PROCEDURE FOR INTERNAL CLEANING OF 9% NICKEL AND HI-PR |
| 990003800 | PEGRAM, J.W. | +APL | MINERAL WOOL APL-ENGR-SPEC-N.02 3P 1/2/70 |
| 990003850 | EVERSON, I. | +APL | MORE ACCIDENTS ON OXYGEN EQUIPMENT APL-SAFETY-BULL-102 1P 2/8/71 |
| 990004220 | EVERSON, I. | +APL | NOTES FOR GUIDANCE OF CUSTOMERS HAVING AIR PRODUCTS LTD OXYGEN EQUIPMEN |
| 990004180 | DAVIES, G. | +APL | OVERHAUL PROCEDURE APL-C-155/9.5 33P 1971 |
| 990004040 | PEGRAM, J.W. | +APL | OXYGEN PIPELINES APL-ENGR-STD-LS.30/1 8P 7/1/70 |
| 990004070 | PEGRAM, J.W. | +APL | PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 275PSIG (CS02.7) |
| 990004090 | | +APL | PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 720PSIG (CS07.2) |
| 990004060 | | +APL | PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 150PSIG (CS0.1.5) |
| 990004060 | | +APL | PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 500PSIG (CS05.0) |
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| 990003720 | PEGRAM, J.W. | +APL | PRESSURE-GAUGE- OXYGEN SERVICE APL-ENGR-SPEC-J.07 3P 6/18/69 |
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| 990004130 | GRAY, G. | +APL | PROCEDURE FOR FILLING CRYOGENIC TANKERS BY PUMP AT BRACKNELL APL-IGD-ENGR- |
| 990004120 | GRAY, G. | +APL | PROCEDURE FOR FILLING CRYOGENIC TANKER BY PUMP AT CARRINGTON APL-IGD-ENGR- |
| 990004140 | GRAY, G. | +APL | PROCEDURE FOR FILLING CRYOGENIC TANKERS BY PUMP AT STOKES-UN-TRENT APL-IGD- |
| 990004170 | CHAMBERS, J. | +APL | PROCEDURE FOR THE INSTALLATION OF A CRYOGENIC TANK APL-IGD-ENGR-MAN-60-01 |
| 990004150 | CHAMBERS, J. | +APL | PURGE PROCEDURE FOR CRYOGENIC LIQUID CONTAINER APL-IGD-ENGR-MAN-52-02 7P |
| 990003950 | EVERSON, I. GRIFFITHS, D.K. | +APL | RECOMMENDATIONS ARISING FROM EXPLOSION OF CRYOSTAR-G8.114-PUMP-NO-C.75 AT CAR |
| 990003740 | PEGRAM, J.W. | +APL | RELIEF VALVES, WARM GAS SERVICE -20F TO 100F APL-ENGR-SPEC-J.18 4P 6/1 |
| 990004210 | ZURAWSKI, J. | +APL | REPORT OF THE INVESTIGATION INTO BURCKHARDT CENTRIFUGAL PUMP EXPLOSION AND TA |
| 990003940 | CROXFORD, B.J. EVERSON, I. | +APL | REPORT ON EXPLOSION OF CRYOSTAR-G8.114-PUMP-NO-C.75 ON TANKER-400-11 2/17/71 |
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| 990003980 | GILLOTT, E. | +APL SOLVENT WASHING OF PIPING SYSTEMS | APL-IGD-ENGR-MAN-56-06 4P 7/3/71 |
| 990003660 | PEGRAM, J.W. | +APL SPECIFICATION FOR OXYGEN SERVICE VESSEL FABRICATION | APL-ENGR-SPEC-C.03 7P |
| 990003670 | PEGRAM, J.W. | +APL SPECIFICATION FOR OXYGEN SERVICE PRESSURE-VESSEL FABRICATION | APL-ENGR-SPEC |
| 990003750 | PEGRAM, J.W. | +APL TRANSFER HOSE FOR CRYOGENIC LIQUIDS | APL-ENGR-SPEC-L.11 3P 7/7/69 |
| 990003770 | PEGRAM, J.W. | +APL UNSINTERED P.T.F.E. TAPE | APL-ENGR-SPEC-L.14 2P 7/8/69 |
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| 990002620 | COWLES, S.W. | +ARMOUR AGRICULTURAL CHEMICAL CO OXYGEN FIRES | AICHE-CEP-TECH-MANUAL SAFETY IN |
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| 990001950 | | +COMPRESSED GAS ASSOC INSULATED TANK-TRUCK SPECIFICATION | CGA-341 FOR COLD LIQUE |
| 990002710 | | +COMPRESSED GAS ASSOC SAFE HANDLING OF COMPRESSED GASES | CGA-PAMPHLET-P-1 10P |
| 990001960 | | +COMPRESSED GAS ASSOC SAFETY RELIEF DEVICE STANDARDS PART-1- CYLINDERS FOR COM | |
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| 990002970 | WRIGHT, G.T. | +DOMINION FOUNDRIES AND STEEL LTD OXYGEN PLANT VAPORIZER EXPLOSION | AICHE-CEP- |
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| 990001290 | | +NASA-HOUSTON NONMETALLIC MATERIALS DESIGN GUIDELINES AND TEST DATA-HANDBOOK MSC | |
| 990001280 | KEY, C.F. RIEHL, W.A. | +NASA-HUNTSVILLE COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN | MTP-P+VE-M-63-14 |
| 990001270 | KEY, C.F. RIEHL, W.A. | +NASA-HUNTSVILLE COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN | NASA-TMX-985 72P |
| 990001250 | KEY, C.F. | +NASA-HUNTSVILLE COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN III | NASA-TMX-5353 |
| 990001260 | KEY, C.F. | +NASA-HUNTSVILLE COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN IV | NASA-TMX-53773 |
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+OFFICE OF PIPELINE SAFETY TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE
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 990005050 APCI METALS, ALLOYS, AND SURFACE TREATMENTS-- STAINLESS STEEL ASTM-A194-8T321 APCI-IA6
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 990004890 APCI METALS, ALLOYS, AND SURFACE TREATMENTS-- PLASITE-NO-7122H WISCONSIN PROTECTIVE CO
 990004960 APCI METALS, ALLOYS, AND SURFACE TREATMENTS-- ALUMINUM ASTM-B210-6061-T6 APCI-IA6A-10
 990005180 APCI METALS, ALLOYS, AND SURFACE TREATMENTS-- COPPER-TUBE ASTM-B88 APCI-IA6A-32 1P
 990004030 APL ALOCLENE-100 AND APPLIED CHEMICALS-5.57 1P 2/5/72
 990001400 ICONE-DC-44, MORSE GREASE, ALPHA-CORP-NOLYKOTE-MICROSIZE, MONSANTO-PYDRAUL, GULF-MECHANISM-HYDROCARBON, HAVOLI
 990003960 EQUIPMENT AT ALCAN-BOOTH ALUMINIUM WORKS ROGERSTONE/NEWPORT 5/18/71 APL-SAFETY-DEPT-REP-37 7P 6/2/71
 990003330 UNEL-PROTECTIVE-EQUIPMENT ALUMINIZED HEAT PROTECTIVE CLOTHING APCI-SAFETY-STD-627.4.7 2P 5/68
 990001580 ND BELOW 300-PSIG-MAX-OWG ALUMINUM APCI-DES-ENG-STD-571.4 3P 11/67
 990001560 ND BELOW 30PSIG-MAX-OWG ALUMINUM APCI-DES-ENG-STD-571.2 3P 11/67
 990001570 ND BELOW 150-PSIG-MAX-OWG ALUMINUM APCI-DES-ENG-STD-571.3 4P 11/67
 990002160 TOUGHNESS STUDY OF WELDED ALUMINUM ALLOY-5083 ASME WINTER ANNUAL-MEETING NEWYORK 8P 11/29/70-12/3/70
 990004950 S, AND SURFACE TREATMENTS-- ALUMINUM ASTM-B209-5083-0 APCI-IA6A-09 2P 2/21/72
 990004960 S, AND SURFACE TREATMENTS-- ALUMINUM ASTM-B210-6061-T6 APCI-IA6A-10 2P 2/21/72
 990004930 S, AND SURFACE TREATMENTS-- ALUMINUM ASTM-B211-2024-T4 APCI-IA6A-07 2P 2/21/72
 990004970 S, AND SURFACE TREATMENTS-- ALUMINUM ASTM-B241-6061-T6 APCI-IA6A-11 2P 2/21/72
 990004980 S, AND SURFACE TREATMENTS-- ALUMINUM ASTM-B247-6061-T6 APCI-IA6A-12 2P 2/21/72
 990004990 S, AND SURFACE TREATMENTS-- ALUMINUM 8361-WP6061-T6 APCI-IA6A-13 2P 2/21/72
 990000870 APCI BRAZED ALUMINUM HEAT-EXCHANGER CLEANING REQUIREMENTS APCI-QUAL-COINT-LAYOUT-119F 2P 7/1
 990003070 -12/71 LIQUID-OXYGEN PUMPS ALUMINUM IN OXYGEN SERVICE LIQUID-CARBON-FLUID-OXYGEN TRAILER- ACCIDENT VICTORY-
 990004010 E FOR INTERNAL CLEANING OF ALUMINUM TANKERS AND STATIC TANKS FOR OXYGEN SERVICE APL-QCP-Q12 REV.0 1P
 990000370 ING-TRANSITION-JOINTS AND ALUMINUM TO STAINLESS-STEEL APCI-DES-ENG-STD-579.15 2P 9/66
 990001890 UN-OXIDES, TALC, ASBESTOS, ALUMINUM-CHIPS, STEEL-WOOL, MAGNESIUM-CHIPS, MAGNESIUM-SHEET, DYE-PENETRANTS, MAGN
 990001110 T CHEMICAL PRODUCTS INC, ALUMINUM-OXIDE, SEAM COMPOUND GEON POLYVINYLCHLORIDE, PLASTIC LEAD SEAL-NO-2-JOHN C
 990001550 S-PLAIN-AND-THREADED-ENDS ALUMINUM-PIPE APCI-DES-ENG-STD-571.1 5P 10/65
 990001020 IPE AND FITTINGS, CLEANING ALUMINUM-PIPE FITTINGS PARTS AND FABRICATIONS, CLEANING STAINLESS-STEEL AND COPPE

990001600 ND BELOW 900-PSIG-MAX-OWG ALUMINUM-TUBE APCI-DES-ENG-STD-571.51 2P 11/1/68
 990001590 ND BELOW 400-PSIG-MAX-OWG ALUMINUM-TUBE APCI-DES-ENG-STD-571.50 2P 11/1/68
 990004940 S, AND SURFACE TREATMENTS- ALUMINUM, ASTM-B-210-3003 APCI-IA6A-08 2P 2/21/72
 990001910 CONSUMER SITES PROPOSED AMENDMENTS PART II AMENDMENTS TO NFPA-NO-566 3P PASSED 5/71 NFPA-NO-50
 990003140 ANUFACTURED LDZ TANKERS BY AMETEK APCI-MEMO-71 06/22/71 IP
 990002950 USTRIES SAFETY IN AIR AND AMMONIA PLANTS AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-2 P
 990000630 10, INDUPOL-POLYBUTENE-OIL AMOCU-H-100, PENTON, I-FILM-THREAD COMPOUND APCI-MAR-87-0-8821 IP 11/61
 990000630 65, INDUPOL-POLYBUTENE-OIL AMOCU-L-10, INDUPOL-POLYBUTENE-OIL AMOCU-H-100, PENTON, I-FILM-THREAD COMPOUND AP
 990002240 SCOTT, D.J. APCI ANALYSES REQUIRED ON QUALITY-CONTROL-SAMPLES APCI-MEMO-68 05/1/68 IP
 990002260 APCI ANALYSES REQUIREMENTS SUMMARY APCI-DIST-OPER-MAN-V-1-SEC-6.32 7P 3/70
 990003580 MCSWAIN, C.B. APCI ANALYSIS OF WATER-HAMMER IN CRYOGENIC TRANSFER-LINES BIBLIOGRAPHY APCI-REPORT P
 990001110 LEAD LUBRICANT AND SEALANT, APCI ANDEROL-L-536 RUST-PREVENTIVE LEHIGH CHEMICAL CO-CHESTER TOWN-MD., PERMACEL-RIBBON-
 990001220 BROPHY, M.+ APCI PERMATX SEALANT-1516- COMPATIBILITY TESTS WITH HIGH-PRESSURE OXYGEN APCI-R
 990002210 -IPD INSPECTION, REGARDING APCI CLEANLINESS REQUIREMENTS APCI-MEMO-71 07/22/71 2P
 990002050 MARYLAND CASUALTY CO APCI FIELD INSPECTION CONTRACT WITH MARYLAND CASUALTY CO APCI-POM-SEC-6.09-ATTC
 990005680 R MALFUNCTION AND FAILURES APCI INCIDENTS INVOLVING OXYGEN-TRANSFER-EQUIPMENT OR INSTRUMENTATION APCI-IIF3-2
 990005610 PIPELINE TRANSPORTATION- APL OXYGEN PIPELINE DESIGN CONCEPTS AND CRITERIA APCI-IIF2-2 IP 2/21/72
 990005590 TRANSFER SYSTEMS SYSTEMS- APL OXYGEN-TRANSFER METHODS TYPICAL INSTALLATIONS, AND OPERATIONS DEPARTMENT OVE
 990000650 DARD IGNITION TEST METHOD, APL PIPING-RESIDUE, METHYLENE-CHLORIDE APCI-MAR-87-0-8821 IP 1/62
 990005900 ENGES HAZARDS PROTECTION APL-BULLETTINS AND REPORTS ON VARIOUS PROBLEMS RELATED TO OXYGEN-SAFETY APCI-IVE-
 990000940 T INVESTIGATION AND REPORT APL-SAFETY-BULLETTINS AND APL-SAFETY DEPARTMENTS RELATED TO ACCIDENTS INVO
 990000940 KITSUN, F.K. APCI APPROVED ALLOY STEELS IN CRYOGENIC SERVICE APCI-SAFETY-GRAM-NO-10-REV-1 IP 10/2
 990001130 ELBERGER, F. APCI PIPING- APPROVED PIPE THREAD SEALANTS APCI-DES-ENG-STD-570.5.1 IP 11/11/60
 990003020 EETING HELD ON BOARD HMS ARK-ROYAL 8/11/71 TO DISCUSS LIQUID-OXYGEN SAFETY REGULATIONS 3P 9/13/71 PLUS N
 990003020 LUS NOTES ON VISIT TO HMS ARK-ROYAL ON 11/8/71 TO DISCUSS SAFETY OF SHIPBOARD LUX-PLANTS 2P 9/13/71
 990003090 ITH OXYGEN JOHNS-MANVILLE ASBESTOS SHEET PACKING STYLE-NO-61 GAVLOCK-900 APCI-IWD-NO-LB-0795 APCI-ANAL
 990003100 900 DURABLA JOHNS-MANVILLE ASBESTOS SHEET PACKING STYLE-61 APCI-MEMO-71 06/2/71 IP PLUS 2P ATTACHMENT
 990001440 NT IN GRAPHITE IMPREGNATED ASBESTOS-PACKING TEFELON COATED ASBESTOS-BLUE APCI-MEMO-60 09/30/60 2P PLUS 1
 990000660 -PACKING, AND IMPREGNATED ASBESTOS-ROPE MATERIAL APCI-MAR-87-0-8821 IP 2/62
 990001890 RUBBER, IRON-OXIDES, TALC, ASBESTOS, ALUMINUM-CHIPS, STEEL-WOOL, MAGNESIUM-CHIPS, MAGNESIUM-SHEET, DYE-PENETRA
 990003450 COMPRESSED GAS ASSOC ASSEMBLY OF OXYGEN REGULATORS T-FILM APCI-MEMO-61 11/30/61 IP
 9900001100 KITSON, F.K. APCI ASSEMBLY OF OXYGEN REGULATORS T-FILM APCI-MEMO-61 11/30/61 IP
 990005070 REATMENTS- STAINLESS STEEL ASTM-A182-F-304 AND ASTM-A182-F-316 APCI-IA6A-21 2P 2/21/72
 990005070 STEEL ASTM-A182-F-304 AND ASTM-A182-F-316 APCI-IA6A-21 2P 2/21/72
 990005030 REATMENTS- STAINLESS STEEL ASTM-A194-8T321 APCI-IA6A-19 2P 2/21/72
 990005020 REATMENTS- STAINLESS STEEL ASTM-A240-304 APCI-IA6A-16 2P 2/21/72
 990005120 REATMENTS- STAINLESS STEEL ASTM-A269-304 APCI-IA6A-26 2P 2/21/72
 990005010 REATMENTS- STAINLESS STEEL ASTM-A312-TP304 APCI-IA6A-15 2P 2/21/72
 990005040 REATMENTS- STAINLESS STEEL ASTM-A320-88304 APCI-IA6A-18 2P 2/21/72
 990005160 REATMENTS- STAINLESS STEEL ASTM-A351-GR-CF8 APCI-IA6A-30 2P 2/21/72
 990005170 SS 9-PERCENT NICKEL STEEL ASTM-A353GB APCI-IA6A-31 2P 2/21/72
 990005030 REATMENTS- STAINLESS STEEL ASTM-A403-WP304 AND A403-WP304L APCI-IA6A-17 2P 2/21/72
 990005150 SUKFACE TREATMENTS- MONEL ASTM-B164 APCI-IA6A-29 2P 2/21/72
 990004950 RFACE TREATMENTS- ALUMINUM ASTM-B209-5083-0 APCI-IA6A-09 2P 2/21/72
 990004950 RFACE TREATMENTS- ALUMINUM ASTM-B210-6061-T6 APCI-IA6A-10 2P 2/21/72
 990004930 RFACE TREATMENTS- ALUMINUM ASTM-B211-2024-T4 APCI-IA6A-07 2P 2/21/72
 990004970 RFACE TREATMENTS- ALUMINUM ASTM-B241-6061-T6 APCI-IA6A-11 2P 2/21/72
 990004980 RFACE TREATMENTS- ALUMINUM ASTM-B247-6061-T6 APCI-IA6A-12 2P 2/21/72
 990005140 NTS- BRASS-SHEET OR PLATE ASTM-B36 APCI-IA6A-28 2P 2/21/72
 990004900 CE TREATMENTS- COPPER-PIPE ASTM-B42 APCI-IA6A-04 1P 2/21/72
 990004920 TREATMENTS- RED-BRASS-PIPE ASTM-B43 APCI-IA6A-06 1P 2/21/72
 990005150 SURFACE TREATMENTS- BRONZE ASTM-B61 OR B62 APCI-IA6A-27 2P 2/21/72
 990004910 CE TREATMENTS- COPPER-TUBE ASTM-B75 APCI-IA6A-05 1P 2/21/72
 990005090 TREATMENTS- COPPER-SILICON ASTM-B98GRB APCI-IA6A-23 2P 2/21/72

990004940 FACE TREATMENTS- ALUMINUM, ASTM-B-210-3003 APCI-IA6A-08 2P 2/21/72
 990001400 O, UCON-HB170, UCON-HB660, AURALUBE-FS, FLUOROLUBE-FS5, KEL-F-LF3, VERSILUBE-F-50, SF81(40)-SILICONE, PYDRAUL-
 990002490 MASTER, H.H. APCI AUTO LOAD SYSTEMS APCI-MEMO-71 05/4/71 2P PLUS 3P ATTACHMENTS
 990001140 I T-FILM THREAD COMPOUND, AUTOIGNITION TEST APCI-ANAL-REP-61-683 APCI-IWO-NO-80-0068 1P 9/18/61
 990002480 MASTER, H.H. APCI LATHROP AUTO-LOAD SYSTEM APCI-MEMO-71 03/22/71 2P PLUS 3P ATTACHMENTS

 990004990 RFACE TREATMENTS- ALUMINUM B361-WP6061-T6 APCI-IA6A-13 2P 2/21/72
 990005660 SPORTATION ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION VIBRATION AND CONTROLLED SLOSHING APCI-IIF2E
 990005650 SPORTATION ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION VEHICLE ACCIDENT PROCEDURES APCI-IIF2D-1 1P
 990005640 SPORTATION ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION OXYGEN-DISPERSAL FROM VENTS AND LINES APCI-I
 990004450 APCI LUBRICANTS- ESSO BEACON-325 APCI-IA1A-17 1P 2/21/72
 990004510 DING COMPOUNDS- MOLYLUBE-N BEL-RAY CO FARMINGDALE/NJ APCI-IA2A-05 1P 2/21/72
 990004400 CI LUBRICANTS- MOLYLUBE-N BEL-RAY CO FARMINGDALE/NJ APCI-IA1A-12 1P 2/21/72
 990004880 ENTS- SEALFAS-MASTIC-31-97 BENJAMIN FOSTER CO APCI-IA6A-02 1P 2/21/72
 990005110 S, AND SURFACE TREATMENTS- BERYLLIUM COPPER APCI-IA6A-25 2P 2/21/72
 990001470 I PRODUCTION OF ROCK WOOL BETHLEHEM-STEEL-CO APCI-MEMO-59 11/12/59 2P
 990003580 CRYOGENIC TRANSFER-LINES BIBLIOGRAPHY APCI-REPORT P86 2/28/64
 990002120 TION CODE- A MANUAL FOR BOILER AND PRESSURE VESSEL INSPECTORS 150P 1968
 990000610 - SPARK-IGNITION, STANDARD BOMB TEST, LED-PLATE-251, PIPE-DOPE APCI-MAR-87-0-8820 1P 9/61
 990000600 TESTING- STANDARD PRESSURE BOMBS AND SPARK-IGNITION, DOW-CORNING FLUORINATED SILICON-OILS, SHELL POLYURETHANE
 990003350 APCI PIPING- EXTENDED BONNET VALVE CODE APCI-DES-ENG-STD-579.4 3P 4/63
 990000780 CLEANING REQUIREMENTS FOR BOURDON-TUBE TYPE GAUGES USED FOR OXYGEN SERVICE APCI-QUAL-CONT-LAYOUT-102F 3P
 990004130 OGENIC TANKERS BY PUMP AT BRACKNELL APL-IGD-ENGR-MAN-50-02 3P 5/27/71
 990000580 EFLUN-HOSES, SUPPORTED BY BRAIDED STAINLESS-STEEL-HOUSING, AND RUBBER-HOSES PLASITE-NO-7122H APCI-MAR-87-0
 990005100 E TREATMENTS- FREE-MACHING BRASS APCI-IA6A-24 2P 2/21/72
 990001510 AIN-AND-THREADED-ENDS- RED BRASS-PIPE APCI-DES-ENG-STD-572.1 5P 5/62
 990005140 S, AND SURFACE TREATMENTS- BRASS-SHEET OR PLATE ASTM-B36 APCI-IA6A-28 2P 2/21/72
 990005240 SURFACE TREATMENTS- ALPHA BRASS-TYPE TCl-100 OR DT0-5019 TUNGUM CO LTD/UK COMPOSITION- COPPER-86-PERCENT
 990000870 APCI BRAZED ALUMINUM HEAT-EXCHANGER CLEANING REQUIREMENTS APCI-QUAL-CONT-LAYOUT-119F
 990003680 PEGRAM, J.W. APL BRAZED CORE EXTENDED SURFACE HEAT-EXCHANGERS APL-ENGR-SPEC-E.02 9P 6/28/70
 990003870 VERNON, I. APL FAILURE OF BRAZED JOINTS IN HIGH-PRESSURE GASEOUS OXYGEN-LINE AT A CYLINDER FILLING DEPOT A
 990002110 STANDARD FOR WELDING AND BRAZING PROCEDURES, WELDERS, BRAZERS, AND WELDING AND BRAZING OPERATORS ASME
 990005130 S, AND SURFACE TREATMENTS- BRONZE ASTM-B61 OR B62 APCI-IA6A-27 2P 2/21/72
 990003440 ILDING OFFICIALS UNIFORM BUILDING CODE VOL-1 1970
 990005880 TEM-EMERGENCIES PROTECTION BUILDINGS AND ADJACENT SYSTEMS PROTECTION APCI-IVC2-1 4P 1/10/72
 990001920 REQUIREMENTS FOR CUSTOMER BULK GAS SUPPLY SYSTEM APCI-DIST-OPER-MAN-V-1-SEC-4.1.3 2P 6/71
 990001930 NSPECTION REQUIREMENTS FOR BULK LIQUID CUSTOMER INSTALLATIONS APCI-DIST-OPER-MAN-V-1-SEC-4.2.3 1P 5/69
 990001900 ON ASSOC INSTALLATION OF BULK OXYGEN SYSTEMS AT CONSUMER SITES-1965 NFPA-NO-566 10P 1965
 990001910 ON ASSOC INSTALLATION OF BULK OXYGEN SYSTEMS AT CONSUMER SITES PROPOSED AMENDMENTS PART II AMENDMENTS
 990001890 YMERS, POLYSULFIDE-SEALER, BUNA-N, NEOPRENE, EPOXY-ADHESIVE, PHENOLIC-MOLDED, MELAMINE-MOLDED, POLYESTER-GLASS
 990003880 OSION AND FIRE OCCURRED IN BURCKHARDT CENTRIFUGAL LOX-PUMP-TYPE-G8114-NO-29224 APL-SAFETY-DEPT-REP-16 6P 2
 990004210 OF THE INVESTIGATION INTO BURCKHARDT CENTRIFUGAL PUMP EXPLOSION AND TANKER FIRE AT SHEEPBRIDGE ALLOY CASTIN
 990003860 ERSUN, I. LANBA, J.S. APL BURCKHARDT OXYGEN COMPRESSOR FIRE AT SSPC ROGNAC PLANT 3/2/71 APL-SAFETY-BULL-1
 990005950 DALY, J. APCI BURNING OF METALS IN OXYGEN ATMOSPHERES (80 TO 100-PERCENT) APCI-TM-186 44P
 990001860 KEHAT, E. APCI BURNING OF STEEL PIPES IN A FLOWING OXYGEN STREAM APCI-MEMO-61 04/17/61 3P PL
 990001480 BROPHY, M. APCI PIPE BURNING TESTS APCI-R+D-NOTEBOOK-111 P26-9 4P 4/17/61
 990002790 APCI NEAR-MISS ACCIDENT- BURNS/HARBOR APCI-MEMO-71 02/8/71 2P
 990001890 UORINATED-SILOXANE, LS-53, BUTYL-RUBBER, IRON-OXIDES, TALC, ASBESTOS, ALUMINUM-CHIPS, STEEL-WOOL, MAGNESIUM-CH
 990002860 APCI BYRON-JACKSON OXYGEN PUMP WASHOUT PROCEDURE FOR ANALYTICAL PURPOSES APCI-POM-SE

 990000730 OLYKOTE-TYPES-Z AND X-15, CABOSIL-M-5 FORMICA-LAMINATE BONDED WITH A PHENOLIC RESIN, CUTTING-OILS, HEXADECAN
 990001890 822, SUPERIOR-GRAPHITE-CO, CALQUARTZ-SODIUM SILICATE, 3M-DC1252-MARKER-PUTTY, DURABLE-MANUFACTURING COMPANY-GA
 990000620 AND MAPLE WOOD, ACTIVATED CARBON APCI-MAR-87-0-8821 1P 10/61
 990001730 O 100F 3600-PSIG-MAX-OWG CARBON STEEL APCI-DES-ENG-STD-578.10.6 3P 6/62

990001650 TO LOOF 275-PSIG-MAX-OWG CARBON STEEL APCI-DES-ENG-STD-578.10.2 4P 10/69
 990001670 APCI IGNITION-LIMITS OF CARBON STEEL IN OXYGEN-NITROGEN-ATMOSPHERES APCI-IWO-NU-LB-0043 APCI-IM-112 6P
 990005000 S, AND SURFACE TREATMENTS- CARBON STEEL (OXYGEN SERVICE) APCI-IA6A-14 3P 2/21/72
 990001020 APCI CLEANING OF CARBON STEEL PIPE AND FITTINGS, CLEANING ALUMINUM-PIPE FITTINGS PARTS AND FABRICA
 990001850 1/2-INCH SAFETY VALVE WITH CARBON STEEL SPRING APCI-IWO-NU-10-7071 APCI-PROJECT-NO-00-5-3248-51.12.50 AP
 990005190 S, AND SURFACE TREATMENTS- CARBON STEEL- NON-OXYGEN SERVICE WITH POSSIBLE EXPOSURE TO OXYGEN APCI-IA6A-33
 990001710 Q LOOF 1440-PSIG-MAX-OWG CARBON STEEL-PIPE APCI-DES-ENG-STD-578.10.4 4P 1/64
 990001840 TU LOOF 150-PSIG-MAX-OWG CARBON STEEL-PIPE APCI-DES-ENG-STD-578.10.19 2P 6/62
 990001720 U LOOF 2000-PSIG-MAX-OWG CARBON STEEL-PIPE APCI-DES-ENG-STD-578.10.5 4P 1/64
 990001680 - PLAIN-AND-THREADED-ENDS- CARBON STEEL-PIPE APCI-DES-ENG-STD-578.10.1 6P 10/65
 990001700 TO LOOF 720-PSIG-MAX-OWG CARBON STEEL-PIPE APCI-DES-ENG-STD-578.10.3 3P 6/62
 990000640 AND EXPLOSION TESTING- CS2 CARBON-DISULFIDE ALIQUIPPA PUMP-SUCTION-FILTER-DEFROST CYL-SEAL SEALING COMPOUND
 990004050 AND SAFETY SATINDARDS FOR CARBON-STEEL GASEGUS OXYGEN TRANSMISSION-LINES APL-ENGR-STD-LS-30/2 3P 1/12/7
 990005280 CALS, SOLVENTS, AND MISC- CARBON-TETRACHLORIDE APCI-IATA-04 1P 2/21/72
 990001060 SCHMUYER, W.W. APCI CARBON-TETRACHLORIDE APCI-SAFETY-GRAM-NO-68 1P 2/21/69
 990001360 OETHANE- TRICHLORETHYLENE- CARBON-TETRACHLORIDE- CHLOROFORM APCI-PROJECT-NO-87-8-8821 APCI-MEMO-62 01/3/76
 990004120 YOGENIC TANKER BY PUMP AT CARRINGTON APL-160-ENGR-MAN-50-01 3P 5/27/71
 990003950 TAR-GB.114-PUMP-NU-C.75 AT CARRINGTON 2/17/71 AS REPORTED IN SAFETY DEPT-REP-35 APL-SAFETY-DEPT-REP-36 6
 990003940 KER-400-11 2/17/71 AT THE CARRINGTON PLANT APL-SAFETY-DEPT-REP-35 7P PLUS APPENDIX I THROUGH VI 19P 3/
 990002670 STOMPLER, R.D. APCI PAUL, CARTER, AND COSMOYNE LOX-PUMP SAFETY APCI-MEMO-71 1/01/26/71 2P
 990000560 SCHMUYER, W.W. APCI CAUTION- SNIFF TESTING CYLINDERS HAS ITS HAZARDS APCI-SAFETY-GRAM-NO-49 2P 3/26
 990003810 APL INSULATION- PREFORMED CELLULAR GLASS SECTION FOR PIPELINES APL-ENGR-SPEC-N.05 5P 10/1/70
 990001400 UALITIES OF CELLULUBE-220, CELLULUBE-150, UCON-LB283, UCON-LB550, UCON-LB300, UCON-LB170, UCON-HB6
 990000740 ES CELLULUBE-300, DTE-103, CELLULUBE-200 RECENT FIRES AT DUPONT-NEW/JOHNSONVILLE-PLANT TITANIUM, TITANIUM-DIOX
 990000730 UT STUDIES, CELLULUBE-300, CELLULUBE-220 APCI-MAR-87-0-8822 2P 6/63
 990000760 -UUT STUDIES CELLULUBE-300 CELLULUBE-220 APCI-MAR-87-0-8822 1P 7/63
 990001400 IRE-RESISTANT QUALITIES OF CELLULUBE-220, CELLULUBE-150, UCON-LB283, UCON-LB550, UCON-LB170, UCON-
 990000760 DS- PLANT-WASH-OUT STUDIES CELLULUBE-300 CELLULUBE-220 APCI-MAR-87-0-8822 1P 7/63
 990000730 ARUS- PLANT-WASH-OUT STUDIES, CELLULUBE-300, DTE 103, RECENT FIRES AT DUPONT-NEW/JOHNSONVILLE-PLANT SOLUNUS-500, T
 990000740 DS- PLANT-WASH-OUT STUDIES CELLULUBE-300, DTE-103, CELLULUBE-200 RECENT FIRES AT DUPONT-NEW/JOHNSONVILLE-PLANT
 990003110 DTE-105 TEXACO-CAPPELLA-AA CELLULUBE-550 FLUOROLUBE SEARS-THREAD-CUTTING-OIL APCI-ANAL-REP 1P 7/15/71
 990003360 GENERAL SPECIFICATION FOR CENTRIFUGAL COMPRESSORS APCI-550-SD-16a 37P 4/15/65
 990003710 GLIVER, K. APL CENTRIFUGAL CRYOGENIC PUMPS APL-ENGR-SPEC-G.03 14P 4/1/71
 990003880 IRE OCCURRED IN BURCKHARDT CENTRIFUGAL LOX-PUMP-TYPE-GB114-NO-29224 APL-SAFETY-DEPT-REP-16 6P 2/28/69
 990000270 CHINERY- FIELD TESTING AND CENTRIFUGAL OXYGEN COMPRESSORS APCI-DES-ENG-STD-551.2.8.1 18P 2/3/71
 990004100 APL CENTRIFUGAL OXYGEN COMPRESSOR MANUAL HATTINGEN PLANT 15P APPENDIX I II III 8P
 990004210 ESTIGATION INTO BURCKHARDT CENTRIFUGAL PUMP EXPLOSION AND TANKER FIRE AT SHEEPBRIDGE ALLOY CASTINGS LTD A
 990002690 GASSEN, K.F. FIRE TESTS ON CENTRIFUGAL PUMPS FOR LIQUID-OXYGEN CRYOGENICS V-10 PP241-248 8P 6/70
 990003070 ALL, W.L. APCI MINUTES OF CGA AIR-SEPARATION EQUIPMENT COMMITTEE HELD AT FT/LAUDERDALE FLORIDA 5/11-12/71
 990001950 TANK-TRUCK SPECIFICATION CGA-341 FOR COLD LIQUEFIED-GASES CGA-PAMPHLET-341-TENTATIVE-STANDARDS 13P 1970
 990003450 NSMISSION AND DISTRIBUTION CGA-DOCKET 70-11 CGA-THIRU DRAFT 23P 3/22/72
 990003830 PL ACCIDENT AT AN OXYGEN CHARGING MANIFOLD APL-SAFETY-BULL-046 2P
 990000520 BALL, W.L. APCI CHECK-LIST- AIR-SEPARATION PLANT-SITE APCI-SAFETY-STD-610.1.1 5P 11/28/60
 990002180 KITSON, F.K. APCI CHECK-LIST-AIR-SEPARATION-PLANT OPERATION APCI-SAFETY-STD-610.1/5 17P 2/16/61
 990005350 MPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CONTROL-APL APCI-IB10(2)-2 2P 2/21/72
 990005340 MPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CONTROL-APCI APCI-IB10(2)-1 3P 9/9/71
 990005310 MPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, CLEANING-PROCEDURES-APCI APCI-IB1C-01 14P 2/21/72
 990005320 MPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, CLEANING-PROCEDURES-APL APCI-IB1C-02 1P 2/21/72
 990005330 MPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CONTROL, FIRE HAZARDS APCI-IB1D(1)-1 2P 9/9
 990005360 MPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY APCI-IB2-1 2P 2/10/72
 990005380 MPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY NOTCH-SENSITIVITY OF MATERIALS APCI-IB2
 990005400 MPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY MATERIALS AND PARTS SUITABILITY CONTROLS
 990005370 MPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY APCI-IB2A-1 2P 9/2/71

990005390 MPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY FABRICATION AND WELDING APCI-IB2D-1 2P
 990004420 LUBRICANTS- FLUORO-GLIDE, CHEMPLAST INC APCI-IA1A-14 1P 2/21/72
 990004580 BOUNDS- SODIUM-SILICATE AND CHINA-CLAY-PASTE APCI-IA2A-12 1P 2/21/72
 990001890 BON-GREASE, HYDRAULIC-OIL, CHLORINATED-BIPHENYL-AROCOR-1254, GRAPHITE-CHLOR-BIPHENYL, VINYL-CHLORIDE, CIS-DIC
 990005270 CALS, SOLVENTS, AND MISC- CHLORCFORM APCI-IA7A-03 1P 2/21/72
 990001360 ENE- CARBON-TETRACHLORIDE- CHLORCFORM APCI-PROJECT-NO-87-8-8821 APCI-MEMO-62 01/3/62 5P
 990001890 URIDE, METHYLENE-CHLORIDE, CHLOROFORM, ETHYL-CHLORIDE, DICHLOROETHANE, DICHLOROETHANE, TRICHLOROETHANE POLYMER
 990001890 CUTITE-CERAMIC-INSULATION, CHROMATE-DYED-GLASS CLOTH, 3M-SAFETY-WALK-TYPE-B-M-0070, WALK-SYNTHETIC-CORK, MASKI
 990001890 -BIPHENYL, VINYL-CHLORIDE, CIS-DICHLOROETHYLENE, TRANS-DICHLOROETHYLENE, VINYLIDENA-CHLORIDE, TRICHLOROETHYLEN
 990000250 APCI CIVIL-STRUCTURAL- PERSONNEL PROTECTIVE SHIELDS AND OXYGEN-SYSTEMS APCI-DES-ENG-ST
 990000840 I REQUIREMENTS FOR VENDOR CLASS-A CLEANING APCI-QUAL-CONT-LAYOUT-115F 2P 7/1/71
 990003610 APL ACCEPTANCE TESTS FOR CLASS-A CLEANING APL-ENGR-SPEC-A.02 3P 5/12/69
 990000800 APCI CLASS-A CLEANLINESS REQUIREMENTS APCI-QUAL-CONT-LAYOUT-105F 3P 7/1/71
 990000850 I REQUIREMENTS FOR VENDOR CLASS-AA CLEANING APCI-QUAL-CONT-LAYOUT-116F 2P 7/1/71
 990003620 APL ACCEPTANCE TEST FOR CLASS-AA CLEANLINESS (OXYGEN-CLEAN) APL-ENGR-SPEC-A.03 4P 4/1/71
 990000810 APCI CLASS-AA CLEANLINESS REQUIREMENTS APCI-QUAL-CONT-LAYOUT-106F 3P 7/1/71
 990000860 I REQUIREMENTS FOR VENDOR CLASS-AAA CLEANING APCI-QUAL-CONT-LAYOUT-117F 3P 7/1/71
 990000820 APCI CLASS-AAA CLEANLINESS REQUIREMENTS APCI-QUAL-CONT-LAYOUT-107F 3P 7/1/71
 990000830 I REQUIREMENTS FOR VENDOR CLASS-B CLEANING APCI-QUAL-CONT-LAYOUT-114F 2P 7/1/71
 990003600 APL ACCEPTANCE TEST FOR CLASS-B CLEANLINESS APL-ENGR-SPEC-A-01 2P 5/12/69
 990000790 APCI CLASS-B CLEANLINESS REQUIREMENTS APCI-QUAL-CONT-LAYOUT-104F 1P 7/1/71
 990001980 SED GAS ASSOC EQUIPMENT CLEANED FOR OXYGEN SERVICE CGA-PAMPHLET-G-4.1 21P 3/59
 990000540 MITH,H. APCI SOLVENT AND CLEANERS- DEVIATIONS CLEANING FOR OXYGEN SERVICE APCI-SAFETY-STD-629.0.10 1P 6/
 990001010 APCI CLEANING APCI-CONSTR-SPEC-230.15 ON P8 1P 9/16/69
 990000890 R,H.H. APCI STORAGE TANK CLEANING APCI-MEMO-63 01/24/63 1P
 990002220 OR-CLASS-AA AND CLASS-AAA CLEANING APCI-MEMO-71 07/22/71 1P
 990000830 REMENTS FOR VENDOR CLASS-B CLEANING APCI-QUAL-CONT-LAYOUT-114F 2P 7/1/71
 990000840 REMENTS FOR VENDOR CLASS-A CLEANING APCI-QUAL-CONT-LAYOUT-115F 2P 7/1/71
 990000860 MENTS FOR VENDOR CLASS-AAA CLEANING APCI-QUAL-CONT-LAYOUT-117F 3P 7/1/71
 990000850 EMENTS FOR VENDOR CLASS-AA CLEANING APCI-QUAL-CONT-LAYOUT-116F 2P 7/1/71
 990003610 CEPTANCE TESTS FOR CLASS-A CLEANING APL-ENGR-SPEC-A.02 3P 5/12/69
 990003650 PING ERECTION, TESTING AND CLEANING APL-ENGR-SPEC-M.02 9P PLUS APPENDIX I II III 4/19/71
 990003970 ING ERECTION, TESTING AND CLEANING APL-ENGR-SPEC-M.02 8P APPENDIX I II III 3P 4/19/71
 990001020 N STEEL PIPE AND FITTINGS, CLEANING ALUMINUM-PIPE FITTINGS PARTS AND FABRICATIONS, CLEANING STAINLESS-STEEL
 990000950 APCI CLEANING AND INSPECTION FOR EQUIPMENT IN AIR PLANTS AND IN OXYGEN SERVICE APCI-PO
 990000500 APCI CLEANING AND INSPECTION- MATERIALS AND OXYGEN SERVICE APCI-SAFETY-STD-608.1 7P
 990003350 GENERAL SPECIFICATION FOR CLEANING FOR OXYGEN SERVICE APCI-550-SD-27A 5P 12/10/59
 990000540 T AND CLEANERS- DEVIATIONS CLEANING FOR OXYGEN SERVICE APCI-SAFETY-STD-629.0.10 1P 6/19/61
 990000940 KITSON,F.K. APCI CLEANING FOR OXYGEN SERVICE APCI-MEMO-63 08/5/63 2P PLUS 9P ATTACHMENTS
 990000960 BASSLER,E.J. APCI CLEANING FOR OXYGEN SERVICE 17P 1/60
 990000900 HATLEY,A.L. APCI CLEANING LOX STORAGE TANK-NO-6 SANTA/SUSANA APCI-MEMO-64 03/11/64 1P PLUS 1P A
 990004010 ITY PROCEDURE FOR INTERNAL CLEANING OF ALUMINUM TANKERS AND STATIC-TANKS FOR OXYGEN SERVICE APL-QCP-Q12 R
 990001020 APCI CLEANING OF CARBON STEEL PIPE AND FITTINGS, CLEANING ALUMINUM-PIPE FITTINGS PARTS
 990004020 ITY PROCEDURE FOR INTERNAL CLEANING OF 9% NICKEL AND HI-PROOF STAINLESS STATIC-TANKS FOR OXYGEN SERVICE AP
 990000930 PENNSALT CORP CLEANING OF LIQUEFIED-GAS PROCESSING EQUIPMENT PENNSALT-TECHNICAL-BULLETIN 6P
 990000360 NG- VALVE PROCUREMENT AND CLEANING PROCEDURE APCI-DES-ENG-STD-579.5 3P 8/12/60
 990005820 MAINTENANCE PROGRAM SAFE CLEANING PROCEDURES FOR FILTERS, TRAPS, AND INSTRUMENTS APCI-IIIB-1 2P 11/1/71
 990000870 ED ALUMINUM HEAT-EXCHANGER CLEANING REQUIREMENTS APCI-QUAL-CONT-LAYOUT-119F 2P 7/1/71
 990000780 APCI CLEANING REQUIREMENTS FOR BOURDON-TUBE TYPE GAUGES USED FOR OXYGEN SERVICE APCI-Q
 990000770 APCI CLEANING REQUIREMENTS FOR AIR-PLANT EQUIPMENT APCI-QUAL-CONT-LAYOUT-101F 2P PLUS
 990001020 S PARTS AND FABRICATIONS, CLEANING STAINLESS-STEEL AND COPPER-PIPE FITTINGS PARTS AND FABRICATIONS DESCRIPT
 990001050 L FIRE HAZARD WHEN VAPOUR CLEANING WITH TRICHLOROETHYLENE (T.C.E.) APL-SAFETY-DEPT-INFO-SHEET-38 2P 2/10
 990002850 MAHR,A.J. APCI LIST OF CLEANING-AGENTS, ASSOCIATED EQUIPMENT AND SUPPLIES APPROVED FOR USE IN APCI MANUF
 990001020 ABRICATIONS DESCRIPTION OF CLEANING-MEDIUMS, INSPECTION OF DECONTAMINATED COMPONENTS, AND PICKLING OF CARBON-

990005310 CHECK, FIRE-COMPATIBILITY, CLEANING-PROCEDURES-APCI APCI-IB1C-01 14P 2/21/72
 990005320 CHECK, FIRE-COMPATIBILITY, CLEANING-PROCEDURES-APL APCI-IB1C-02 1P 2/21/72
 990003600 ACCEPTANCE TEST FOR CLASS-B CLEANLINESS APL-ENGR-SPEC-A-01 2P 5/12/69
 990003620 ACCEPTANCE TEST FOR CLASS-AA CLEANLINESS (OXYGEN-CLEAN) APL-ENGR-SPEC-A.03 4P 4/1/71
 990005450 DISPOSAL OF VENTED GASES CLEANLINESS OF DISPOSAL SYSTEM APCI-IIB1-1 2P 2/12/72
 990005470 DISPOSAL OF VENTED GASES CLEANLINESS OF OXYGEN PIPING APCI-IIB1-2 1P 2/19/72
 990000810 APCI CLASS-AA CLEANLINESS REQUIREMENTS APCI-QUAL-CONT-LAYOUT-106F 3P 7/1/71
 990000790 APCI CLASS-B CLEANLINESS REQUIREMENTS APCI-QUAL-CONT-LAYOUT-104F 1P 7/1/71
 990000800 APCI CLASS-A CLEANLINESS REQUIREMENTS APCI-QUAL-CONT-LAYOUT-105F 3P 7/1/71
 990000820 APCI CLASS-AAA CLEANLINESS REQUIREMENTS APCI-QUAL-CONT-LAYOUT-107F 3P 7/1/71
 990002210 INSPECTION, REGARDING APCI CLEANLINESS REQUIREMENTS APCI-MEMO-71 07/22/71 2P
 990003330 LUMINIZED HEAT PROTECTIVE CLOTHING APCI-SAFETY-STD-627.4.7 2P 5/68
 990001890 NVILLE-76 GASKET MATERIAL, CLOTH-ASBESTOS, GLASS-COTTON-ALUMINIZED-MIL-C-8240, COCOTITE-CERAMIC-INSULATION, CH
 990001890 ATION, CHROMATE-DYED-GLASS CLOTH, 3M-SAFETY-WALK-TYPE-B-M-0070, WALK-SYNTHETIC-CORK, MASKING-TAPE, SHERLOCK-LE
 990002520 FIRE INCIDENT IN AN OXYGEN CLOUD FIRE JOURNAL PP76-8 AND 81 4P 1/71
 990001500 APCI PLASITE PROTECTIVE COATING APCI-MEMO-60 06/9/60 2P
 990001890 TON-ALUMINIZED-MIL-C-8240, COCOTITE-CERAMIC-INSULATION, CHROMATE-DYED-GLASS CLOTH, 3M-SAFETY-WALK-TYPE-B-M-007
 990002040 APCI CODED VESSEL REPAIRS APCI-POM-SEC-6.09 4P 11/29/68 FOR ATTCHMTS SEE 205 206
 990002280 APCI CODED VESSEL REPAIRS APCI-POM-SEC-6.09 4P 15P OF ATTCHMTS 11/29/68
 990001950 SPECIFICATION CGA-341 FOR COLD LIQUEFIED-GASES CGA-PAMPHLET-341-TENTATIVE-STANDARDS 13P 1970
 990001850 FOSTER, R.H. APCI COLD TEST OF 1/2-INCH SAFETY VALVE WITH CARBON STEEL SPRING APCI-IWO-NO-10-7071
 990002270 APCI COLD-BOX LEAKS APCI-POM-SEC-1.14 5P 10/30/68
 990000450 APCI PLANT COMPONENTS- COLD-BOXES APCI-SAFETY-STD-607.1.5 7P 1/63
 990000380 PERLITE IN AIR-SEPARATION COLD-BOXES APCI-TB-39 1P 6/14/71
 990000390 INSULATION AND PAINTING- COLD-BOXES THERMAL TANKS PERLITE APCI-DES-ENG-STD-581.1 4P 5/26/61
 990000410 INSULATION AND PAINTING- COLD-BOXES, THERMAL TANKS, GLASS WOOL APCI-DES-ENG-STD-581.3 1P 10/24/60
 990001800 APCI PIPING-SS36- COLD-BOX-SERVICE 100F AND BELOW 3600-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES
 990001770 APCI PIPING-SS12- COLD-BOX-SERVICE 100F AND BELOW 1235-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES
 990001810 APCI PIPING-SS7.2- COLD-BOX-SERVICE 100F AND BELOW 720-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES
 990001750 APCI PIPING-SS2.7- COLD-BOX-SERVICE 100F AND BELOW 275-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES
 990001760 APCI PIPING-SS6- COLD-BOX-SERVICE 100F AND BELOW 615-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES
 990001790 APCI PIPING-SS30- COLD-BOX-SERVICE 100F AND BELOW 3000-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES
 990001620 APCI PIPING-CT2- COLD-BOX-SERVICE 100F AND BELOW 200-PSIG-MAX-OWG COPPER-TUBE APCI-DES-ENG-STD-
 990001570 APCI PIPING-AA1.5- COLD-BOX-SERVICE 100F AND BELOW 150-PSIG-MAX-OWG ALUMINUM APCI-DES-ENG-STD-571.
 990001630 APCI PIPING-CT4- COLD-BOX-SERVICE 100F AND BELOW 400-PSIG-MAX-OWG COPPER-TUBE APCI-DES-ENG-STD-
 990001580 APCI PIPING-AA3- COLD-BOX-SERVICE 100F AND BELOW 300-PSIG-MAX-OWG ALUMINUM APCI-DES-ENG-STD-571.
 990001560 APCI PIPING-AA.3- COLD-BOX-SERVICE 150F AND BELOW 30PSIG-MAX-OWG ALUMINUM APCI-DES-ENG-STD-571.2
 990001640 APCI PIPING-ICT4- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 400-PSIG-MAX-OWG COPPER
 990001600 APCI PIPING-IAA9- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 900-PSIG-MAX-OWG ALUMIN
 990001670 APCI PIPING-ICT23- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 2300-PSIG-MAX-OWG COPPE
 990001650 APCI PIPING-ICT9- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 900-PSIG-MAX-OWG COPPER
 990001590 APCI PIPING-IAA4- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 400-PSIG-MAX-OWG ALUMIN
 990001660 APCI PIPING-ICT10- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 1000-PSIG-MAX-OWG COPP
 990000400 INSULATION AND PAINTING- COLD-INSULATION AND MINERAL FIBER GRANULATED APCI-DES-ENG-STD-581.2 2P 6/26/69
 990001440 BALL, W.L. APCI COMBUSTIBLE CONTAMINANT CONTENT IN GRAPHITE IMPREGNATED ASBESTOS-PACKING TEFLON CO
 990001420 KET MATERIALS WITH OXYGEN COMBUSTION IN OXYGEN AND SOXHLET ETHER-EXTRACTION GARLOCK-900, KM-226, KM-246 AP
 990001410 RATH MATERIAL WITH OXYGEN COMBUSTION IN OXYGEN AND SOXHLET ETHER-EXTRACTION MELRATH GARLOCK-900 APCI-ANAL-R
 990001200 BROPHY, M. APCI OXYGEN COMPATABILITY TESTS- MOLYLUBE-KOTE-AR AND MOLYLUBE-N APCI-R+D-NOTEBOOK-130 P16-
 990001220 CI PERMATHEX SEALANT-1516- COMPATABILITY TESTS WITH HIGH-PRESSURE OXYGEN APCI-R+D-NOTEBOOK-111 P152 1P 1/
 990001370 APCI HIGH-PRESSURE OXYGEN COMPATABILITY TESTS WITH SILICONE-RUBBER GASKET COMPOUND- RTV-60-NP-134372-M235 A
 990001420 R. APCI GASKET MATERIALS COMPATABILITY OF GASKET MATERIALS WITH OXYGEN COMBUSTION IN OXYGEN AND SOXHLET ET
 990005350 I MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CONTROL-APL APCI-IB1D(2)-2 2P
 990005330 I MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CONTROL, FIRE HAZARDS APCI-IB1D
 990005340 I MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CONTROL-APCI APCI-IB1D(2)-1 3P

990005320 I MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, CLEANING-PROCEDURES-APL APCI-IBIC-02 IP
 990005310 I MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, CLEANING-PROCEDURES-APCI APCI-IBIC-01 I
 990005370 I MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY APCI-IB2A-1 2P 9/27/71
 990005400 I MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY MATERIALS AND PARTS SUITABI
 990005580 I MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY NOTCH-SENSITIVITY OF MATERI
 990005360 I MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY APCI-IB2-1 2P 2/10/72
 990005390 I MATERIAL-COMPATIBILITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY FABRICATION AND WELDING A
 990005970 NASA-KENNEDY MATERIALS COMPATIBILITY FOR GASEOUS OXYGEN SYSTEMS MAB-3268-69 9P 11/5/69
 990001130 R.A. APCI GASEOUS OXYGEN COMPATIBILITY OF GROSSITE FLUOROCARBON TAPE THREE-M-FLUOROCARBON-TAPE, PERMACEL-TA
 990003090 L.G. LATSHAW,D.R. APCI COMPATIBILITY OF MATERIAL WITH OXYGEN JOHNS-MANVILLE ASBESTOS SHEET PACKING STY
 990005960 T.AL UNION CARBIDE CORP COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN AD08260 71P 10/64
 990001270 EHL,W.A. NASA-HUNTSVILLE COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN NASA-TMX-985 72P 8/64
 990001280 EHL,W.A. NASA-HUNTSVILLE COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN MTP-P+VE-M-63-14 94P 12/4/63
 990001260 KEY,C.F. NASA-HUNTSVILLE COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN IV NASA-TMX-53773 50P 8/23/68
 990001250 KEY,C.F. NASA-HUNTSVILLE COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN III NASA-TMX-53533 54P 11/3/66
 990001240 KEY,C.F. NASA-HUNTSVILLE COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN NASA-TMX-53052 34P 5/26/64
 990000510 SCHMOYER,W.W. APCI COMPATIBILITY OF MATERIALS- OXYGEN COMPATIBLE MATERIALS APCI- SAFETY-STD-609.1 8P
 990001890 HAUSER,R.L. MARTIN CO COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN METHYL-CHLORIDE, APCI- SAFETY-STD-609.1 8P
 990001410 K. APCI GASKET MATERIAL COMPATIBILITY OF MELRATH MATERIAL WITH OXYGEN COMBUSTION IN OXYGEN AND SOXHLET ETH
 990001170 R.A. APCI GASEOUS OXYGEN COMPATIBILITY TESTS ON MOLY-LUBE-NG-99 APCI-MEMO-63 06/11/63 1P
 990001110 DINAN,E. APCI OXYGEN COMPATIBILITY TESTS FOR VARIOUS MATERIALS- ABMA THREKAD LUBRICANT AND SEALANT, ANDE
 990001230 BROPHY,M. APCI MOLLY-99 COMPATIBILITY TESTS WITH HIGH-PRESSURE OXYGEN APCI-R+D-NOTEBOOK-130 P3 1P 6/63
 990001320 KEL-F HIGH-PRESSURE OXYGEN COMPATIBILITY- NYLON APCI-MEMO-63 05/17/63 1P
 990000510 ILITY OF MATERIALS- COMPATIBLE MATERIALS APCI- SAFETY-STD-609.1 8P 6/65
 990002370 ANADIAN STANDARDS ASSOC COMPRESSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS CSA-896 57P 1965
 990002360 MERICAN STANDARDS ASSOC COMPRESSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS ASA-857.1 57P 1965
 990002350 COMPRESSED GAS ASSOC COMPRESSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS CGA-PAMPHLET-V-1 57P
 990002880 RUCTION FOR REGULATORS AND COMPRESSED GASES APCI-BROCHURE 4P 4/70
 990002710 S ASSOC SAFE HANDLING OF COMPRESSED GASES CGA-PAMPHLET-P-1 10P 1965
 990001960 RDS PART-1- CYLINDERS FOR COMPRESSED GASES CGA-PAMPHLET-S-1.1 20P 1969
 990004230 I. APL FIRE HAZARDS IN COMPRESSED-AIR AND OXYGEN RICH ENVIRONMENTS APL- SAFETY-DEPT-INFO-SHEET-33 6P
 990003150 EF DEVICE STANDARDS PT-3 COMPRESSED-GAS STORAGE-CONTAINERS CGA-PAMPHLET-S-1.3 11P 1966
 990000490 URAGE, VACUUM-SYSTEMS, AND COMPRESSED-GASES APCI- SAFETY-STD-607.2.2.5 P1-4 3/65 P5-6 1/64
 990003380 EQUIPMENT ERECTION OXYGEN COMPRESSIVE-LOADS AT AMBIENT AND LIQUID-NITROGEN TEMPERATURES APCI-CUNSTR-SPEC-200.0 TO 200.20 20P 8/77
 990001340 BEHAVIOR OF TRANSITE UNDER COMPRESSOR APCI- SAFETY-STD-607.1.2.3 6P 12/62
 990000440 S- AIR-SEPARATION, OXYGEN, COMPRESSOR APCI- SAFETY-GRAM-NU-03 2P 7/77/61
 990002600 BALL,W.L. APCI OXYGEN COMPRESSOR FIRE AT SSPC RUSNAC PLANT 3/2/71 APL- SAFETY-BULL-107 3P 4/14/71
 990003860 S. APL BURCKHARDT OXYGEN COMPRESSOR FIRE AT SSPC RUSNAC PLANT 15P APPENDIX I II III 8P
 990004100 APL CENTRIFUGAL OXYGEN COMPRESSOR MANUAL HATTINGEN PLANT 15P APPENDIX I II III 8P
 990002910 REENS TO BE USED IN OXYGEN COMPRESSOR SUCTION APCI-MEMO-71 07/26/71 2P
 990002560 APCI PIPING- OXYGEN COMPRESSOR SYSTEM APCI OPERATED APCI-DES-ENG-STD-570.7 32P 7/19/71
 990000290 G KA-27-1V/KA-4-IV OXYGEN COMPRESSOR LOCATION APCI-DES-ENG-STD-570.6 2P 1/15/71
 990003050 FICATION FOR RECIPROCATING COMPRESSORS APCI-550-SD-01A 37P 3/9/64
 990003370 CIFICATION FOR CENTRIFUGAL COMPRESSORS APCI-550-SD-16A 37P 4/15/65
 990000260 G AND RECIPROCATING OXYGEN COMPRESSORS APCI-DES-ENG-STD-551.1.9.1 14P 2/3/71
 990000270 ING AND CENTRIFUGAL OXYGEN COMPRESSORS APCI-DES-ENG-STD-551.2.8.1 18P 2/3/71
 990005700 MALFUNCTIONS AND FAILURES COMPRESSORS AND PUMPS APCI-IF3-4 15P 1/23/72
 99000110 BRUNSWICK/NEW/JERSEY, WEST CONCRETE FLOOR TREATMENT WEST CHEMICAL PRODUCTS INC, ALUMINUM-OXIDE, SEAM COMPOUN
 990002200 W.L. APCI LOX-SPILL NCG CONSHORCKEN APCI-MEMO-68 05/23/68 2P
 990001440 LL,W.L. APCI COMBUSTIBLE CONTAMINANT CONTENT IN GRAPHITE IMPREGNATED ASBESTOS-PACKING TEFLON COATED ASPBEST
 990005550 APCI OPERATIONAL-HAZARDS- CONTAMINANTS ACCUMULATION APCI-IIE-1 1P 7/21/71
 990001150 PERCENT ETHER EXTRACTABLE CONTAMINANTS AND FLUORESCENCE DAMCO-TEFLON TAPE, SANDEM-INDUSTRIAL, CRANE PACKING
 990001080 CI NOTES ON LIQUID OXYGEN CONTAMINANTS MISSILE-PROGRAM 10P 1/6/58

990000970 APCI AIR-SEPARATION-PLANT CONTAMINATION- HISTORY, SAMPLING, AND ANALYSIS APCI PLANT MANAGERS SAFETY MEE
 990000980 D PIPELINE-TRANSPORTATION CONTROL APCI-IIF2B-1 IP 9/3/71
 990002030 CO APCI FIELD INSPECTION CONTRACT WITH HARLAND CASUALTY CO APCI-POW-SEC-6.09-ATTCHMT-1 2P 8/27/69
 990002430 APCI OXYGEN CONTROL-PANEL APCI-DES-ENG-STD-534.1 (TO BE PUBLISHED)
 990000570 GEIST,J.M. APCI CONTROLLED KINETICS EXPERIMENTATION- TEFLON-HOSE APCI-HAR-87-G-8820 IP 5/60
 990000560 GEIST,J.M. APCI CONTROLLED KINETICS EXPERIMENTS- TEFLON-HOSES, SUPPORTED BY BRAIDED STAINLESS-STEEL COPPER APCI-IA6A-25 2P 2/21/72
 990005110 FACE TREATMENTS- BERYLLIUM COPPER APCI-IA6A-04 IP 2/21/72
 990004900 S, AND SURFACE TREATMENTS- COPPER-PIPE FITTINGS PARTS AND FABRICATIONS DESCRIPTION OF CLEANING-METHODS, INSP
 990001020 LAINING STAINLESS-STEEL AND COPPER-PIPE COPPER-PIPE FITTINGS PARTS AND FABRICATIONS DESCRIPTION OF CLEANING-METHODS, INSP
 990005070 S, AND SURFACE TREATMENTS- COPPER-SILICON ASTM-6986K6 APCI-IA6A-23 2P 2/21/72
 990001610 RATING TABLES- PLAIN-ENDS COPPER-TUBE APCI-DES-ENG-STD-574.1 5P 5/62
 990001650 BELOW -1000-PSIG-MAX-OWG COPPER-TUBE APCI-DES-ENG-STD-574.52 IP 4/67
 990001650 NO BELOW 900-PSIG-MAX-OWG COPPER-TUBE APCI-DES-ENG-STD-574.51 2P 11/1/68
 990001640 NO BELOW 400-PSIG-MAX-OWG COPPER-TUBE APCI-DES-ENG-STD-574.50 2P 11/1/68
 990001670 D BELOW 2300-PSIG-MAX-OWG COPPER-TUBE APCI-DES-ENG-STD-574.54 2P 1/64
 990004910 S, AND SURFACE TREATMENTS- COPPER-TUBE ASTM-875 APCI-IA6A-05 IP 2/21/72
 990005180 S, AND SURFACE TREATMENTS- COPPER-TUBE ASTM-888 APCI-IA6A-32 IP 2/21/72
 990003680 PEGRAM,J.W. APL BRAZED CORE EXTENDED SURFACE HEAT-EXCHANGERS APL-ENGR-SPEC-E.02 9P 6/28/70
 990003560 STANDARDS REQUIREMENTS FOR CORROSION CONTROL FEDERAL REGISTER VOL-36 NO-126 6/30/71
 990003550 STANDARDS FOR GAS PIPELINES CORROSION-PITTING- NOTICE OF PUBLIC HEARING FEDERAL REGISTER VOL-36 NO-126 6
 990002670 APCI PAUL, CARTER, AND COSMODYNE LOX-PUMP SAFETY APCI-MEMO-71 1/01/26/71 2P
 990002250 QUALITY ASSURANCE PROGRAM COST-PROCEDURES DIST-OPER-MAN-VOL-4-SECT-6.3 APCI-REMO-66 10/17/66 2P PLUS SCH
 990005490 APCI OPERATIONAL-HAZARDS- COUPLING TO OTHER SYSTEMS APCI-IICI-1 APCI-IIC2-1 IP 12/22/71
 990002160 K. LEHIGH UNIV FATIGUE CRACK GROWTH-RATES AND FRACTURE TOUGHNESS STUDY OF WELDED ALUMINUM ALLUOY-5083 AS
 990002140 F MEAN STRESS ON FATIGUE CRACK-PROPAGATION IN PLATES UNDER EXTENSION AND BENDING ASME WINTER ANNUAL
 990002130 UNIV COMPARATIVE STUDY OF CRACK-PROPAGATION IN PLATES UNDER EXTENSION AND BENDING INTERNATIONAL CONFERE
 990001110 LASTIC LEAD SEAL-NO-2-JOHN CRANE APCI-MEMO-59 01/28/59 2P
 990001150 N TAPE, SANDEN-INDUSTRIAL, CRANE PACKING CO APCI-ANAL-REP-70-368.70-369 IP 10/7/70
 990004530 S AND THREADING COMPOUNDS- CRANE PACKING CO TAPE APCI-IA2A-09 2P 2/21/72
 990002810 APCI NEAR-MISS ACCIDENT- CREIGHTON APCI-MEMO-68 06/4/68 2P
 990003120 ESTIN- 7139-CATALYST) FROM CREST PRODUCTS CO APCI-IMD-ND-XD-0134 APCI-ANAL-REP-71-446 IP 10/25/71
 990001130 US OXYGEN COMPATIBILITY OF CROSSLITE FLUOROCARBON TAPE THREE-M-FLUOROCARBON-TAPE, PERMACEL-TAPE APCI-MEMO-63
 990004520 S AND THREADING COMPOUNDS- CROSSLITE-FLUOROCARBON-TAPE APCI-IA2A-06 2P 2/21/72
 990002380 OCCURE FOR TRANSPORTABLE CRYOGENIC CONTAINERS (250-GALLON CAPACITY OR LARGER) GENERAL APCI-POW-SEC-2.02
 990002390 OCCURE FOR TRANSPORTABLE CRYOGENIC CONTAINERS (250-GALLON CAPACITY OR LARGER) APCI-DIST-OPER-MAN-9.1 6P
 990004150 APL PURGE PROCEDURE FOR CRYOGENIC LIQUID CONTAINER APL-IGD-ENG-MAN-52-02 7P 6/3/71
 990003780 SYSTEMS- FIELD FABRICATED CRYOGENIC LIQUID HOSE-COUPPLINGS FOR USE IN THE U.K. APL-ENGR-STD-LS.08 6P 10/2
 990005260 APL TRANSFER HOSE FOR CRYOGENIC LIQUID STORAGE TANKS APCI-IIFI-3 IP 2/3/72
 990003750 APCI SAFE HANDLING OF CRYOGENIC LIQUIDS APL-ENGR-SPEC-L.11 3P 7/7/69
 990002650 INSULATION MATERIALS FOR CRYOGENIC LIQUIDS AND ASSOCIATED EQUIPMENT APCI-POW-SEC-L.17 8P 4/23/69
 990003580 ANALYSIS OF WATER-HAMMER IN CRYOGENIC SYSTEMS MILFOAM URETHANE INSULATION NATIONAL-GYPSUM-BLUE LOX-SYSTEMS FCA
 990000150 URE-VESSELS- VAPORIZER AND CRYOGENIC LIQUID DISPOSAL APCI-DES-ENG-STD-514.6.2 4P 5/26/61
 990003410 ION FOR A FIELD-FABRICATED CRYOGENIC LIQUID STORAGE-TANK (FLAT-BOTTOM) APCI-99820A 18P 9/15/71
 990002150 US TO SAFE-LIFE DESIGN IN CRYOGENIC PRESSURE-VESSELS ESSO-REPORT-NU-EE-26ER.70 17P 8/24/70
 990003710 LIVER,R. APL CENTRIFUGAL CRYOGENIC PUMPS APL-ENGR-SPEC-S.03 14P 4/1/71
 990006010 CRYOGENIC SAFETY APCI CRYOGENIC SAFETY CONFERENCE ALLENTOWN 145P 7/59
 990000040 APPROVED ALLOY STEELS IN CRYOGENIC SERVICE APCI-ENGR-MAN-NO-10-REV-1 IP 10/25/63
 990004170 FOR THE INSTALLATION OF A CRYOGENIC TANK APL-IGD-ENGR-MAN-60-01 6P 5/19/71
 990004120 APL PROCEDURE FOR FILLING CRYOGENIC TANKER BY PUMP AT LARRINGTON APL-IGD-ENGR-MAN-50-01 3P 5/27/71
 990004140 APL PROCEDURE FOR FILLING CRYOGENIC TANKERS BY PUMP AT STOKES-ON-THE-EN APL-IGD-ENGR-MAN-50-03 3P 5/27/71
 990004130 APL PROCEDURE FOR FILLING CRYOGENIC TANKERS BY PUMP AT BRACKSHELL APL-IGD-ENGR-MAN-50-02 3P 5/27/71
 990000480 AGE, CONVERTER-SYSTEM, AND CRYOGENIC-LIQUIDS APCI-ENGR-SPEC-607.2.1.1 3P 4/62
 990000470 NTS- AIR-SEPARATION PLANT, CRYOGENIC-LIQUID, AND DISPOSAL APCI-ENGR-SPEC-607.1.1.20 3P 4/62

990003590 S COUNCIL SAFETY PANEL CRYGENICS SAFETY MANUAL P122 1970 14P
990003930 I. APL INVESTIGATION OF KYUSTAR LOX-PUMP EXPLOSION AT STOKO PLANT 8/7/70 APL-SAFETY-DEPT-REP-34 14P
990003920 LSION AND FIRE DUE TO THE CRYOSTAR-G8114 LOX-PUMP ON AN SSPC LUX-TANKER APL-SAFETY-DEPT-REP-32 9P 7/10/7
990003940 PL REPORT ON EXPLOSION OF CRYOSTAR-G8.114-PUMP-NO-C.75 ON TANKER-400-11 2/17/71 AT THE CARRINGTON PLANT A
990003950 ARISING FROM EXPLOSION OF CRYOSTAR-G8.114-PUMP-NO-C.75 AT CARRINGTON 2/17/71 AS REPORTED IN SAFETY DEPT-RE
990004640 US, AND EXPLOSION TESTING- CS2 CARBON-DISULFIDE ALIQUIPPA PUMP-SUCTION-FILTER-DEFROST CYL-SEAL SEALING COMPUUN
990004840 TS AND PACKINGS- SINDANYU CS2 CARBON-DISULFIDE ALIQUIPPA PUMP-SUCTION-FILTER-DEFROST CYL-SEAL SEALING COMPUUN
990006190 NSECTION REQUIREMENTS FOR CUSTOMER BULKS GAS SUPPLY SYSTEM APCI-DIST-OPER-MAN-V-1-SEC-4.1.3 2P 6/71
990006130 QUIREMENTS FOR BULK LIQUID CUSTOMER INSTALLATIONS APCI-DIST-OPER-MAN-V-1-SEC-4.2.3 1P 5/69
990002420 S SYSTEMS FOR WELDING AND CUTTING NFPA-NO-51 8P 1969 AND CUTTING AND WELDING PROCESSES NFPA-NO-51B 3
990002720 ETY SAFETY IN WELDING AND CUTTING USAS-249.1 49P 1967
990002890 DUCTS REDI-SET WELDING AND CUTTING OUTFITS APCI-BROCHURE IIP 9/25/69
990002010 THE CHEMICAL STRUCTURE OF CUTTING OILS TO THEIR OXYGEN-COMPATIBILITY AICHE-CEP-TECH-MANUAL SAFETY IN AIR
990000720 ROS- KEL-F-POLYMER, NYLON, CUTTING-OILS APCI-MAR-87-0-8822 1P 5/63
990000730 DEO WITH A PHENOLIC RESIN, CUTTING-OILS, HEXADECANE, HYDROCARBON TYPE CUTTING-OILS, KNOWN AS TYPE-GROUP-II, PL
990000730 XADECANE, HYDROCARBON TYPE CUTTING-OILS, KNOWN AS TYPE-GROUP-II, PLANT WASH-OUT STUDIES, CELLULRE-300, CELLUL
990000160 LS- GASEOUS OXYGEN STORAGE CYLINDER APCI-DES-ENG-STD-515.1.3 3P 10/17/60
990000050 CHMOYER, W.W. APCI OXYGEN CYLINDER FAILURE APCI-SAFETY-GRAM-NO-13 2P 6/1/62
990004160 ERS, J. APL PROCEDURE FOR CYLINDER FILLING AND QUALITY CONTROL (STANDARD PURITY GASES) APL-ICD-ENGR-MAN
990003870 GASEOUS OXYGEN-LINE AT A CYLINDER FILLING DEOPT APL-SAFETY-BULL-114 3P 7/13/71
990000010 F.K. APCI DCM_T TURN A CYLINDER INTO A ROCKET APCI-SAFETY-GRAM-NO-04C 1P 8/7/61
990002370 US ASSOC COMPRESSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS CSA-B96 57P 1965
990002350 AS ASSOC COMPRESSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS CGA-PAMPHLET-V-1 57P 1965
990002360 DS ASSOC COMPRESSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS ASA-B57.1 57P 1965
990000100 ER, W.W. APCI SNIFF THOSE CYLINDERS BEFORE REFILLING APCI-SAFETY-GRAM-NO-31 2P 8/21/63
990001960 DEVICE STANDARDS PART-1- CYLINDERS FOR COMPRESSED GASES CGA-PAMPHLET-S-1.1 20P 1969
990000560 CI CAUTION- SNIFF TESTING CYLINDERS HAS ITS HAZARDS APCI-SAFETY-GRAM-NO-49 2P 3/26/65
990000640 UMP-SUCTION-FILTER-DEFROST CYL-SEAL SEALING COMPOUND APCI-MAR-87-0-8821 1P 12/61

990004530 S AND THREADING COMPOUNDS- DAMCO TAPE APCI-1A2A-07 2P 2/21/72
990001150 TAINANTS AND FLUORESCENCE DAMCO-TEFLON TAPE, SANDEN-INDUSTRIAL, CRANE PACKING CO APCI-ANAL-REP-70-368, 70-
990003190 APCI AND THEN THERE WAS DARKNESS APCI-SAFETY-GRAM-NO-58 1P 3/15/67
990005940 EOUS OXYGEN SAFETY REVIEW DATA- ACCIDENT/INCIDENT INVESTIGATION AND REPORT-APCI DOCUMENTS LIST COVERING SA
990001290 DESIGN GUIDELINES AND TEST DATA-HANDBOOK MSC-02681 380P 5/29/70
990001020 ING-MEDIUMS, INSPECTION OF DECONTAMINATED COMPONENTS, AND PICKLING OF CARBON-STEEL PIPE AND FITTINGS APCI
990003640 VES-OXYGEN SERVICE-MINIMUM DECONTAMINATION AND TEST REQUIREMENTS APL-ENGR-SPEC-L.06 4P 7/7/69
990003990 APL GENERAL PROCEDURE FOR DECONTAMINATION OF STATIC-TANK AND ROAD-VEHICLE-ASSEMBLIES FOR OXYGEN SERVICE AP
990003490 THIELSCH, P. GRINNELL CO DEFECTS AND FAILURES IN PRESSURE-VESSELS AND PIPING REINHOLD PUBLISHING CORP 427P
990001070 QUIPPA PUMP-SUCTION FILTER DEFROST AND OF METHYLENE-CHLORIDE APCI-MEMO-61 12/11/61 2P
990002500 PROBLEM VAPOR-CLOUDS FROM DEFROST OPERATIONS ALLEGEDLY CAUSED HIGHWAY ACCIDENT APCI-SAFETY-GRAM-NO-17 1P
990003630 PEGRAM, J.W. APL DEGREASING ACCEPTANCE TESTS FOR OXYGEN SERVICE COMPRESSORS APL-ENGR-SPEC-K.02 3
990004000 RING QUALITY PROCEDURE FOR DELUGE-SYSTEM AND LOX LOADING APL-GCP-Q11 REV.0 2P
990003870 FIRE-PROTECTION EQUIPMENT- DELUGE-SYSTEM AND LOX LOADING FACILITY APCI-SAFETY-STD-630.2.6 3P 1/64
990003430 LINE AT A CYLINDER FILLING DEPT APL-SAFETY-BULL-114 3P 7/13/71
990004030 NST RECOMMENDED RULES FOR DESIGN AND CONSTRUCTION OF LARGE, WELDED, LOW-PRESSURE STORAGE TANKS API STANDA
990001290 TON NONMETALLIC MATERIALS DESIGN AND SAFETY SATNDARDS FOR CARBON-STEEL GASEOUS OXYGEN TRANSMISSION-LINES
990001070 REHAT, E. APCI DESIGN GUIDELINES AND TEST DATA-HANDBOOK MSC-02681 380P 5/29/70
990000660 E-GREASES, EPOXY COMPOUNDS DETONATION TESTS OF OIL FROM ALIQUIPPA PUMP-SUCTION FILTER DEFROST AND OF METHYLENE
990000660 COMPOUNDS DEVCON-2-TUN AND DEVCON-F, FOAM-TYPE INSULATIONS STYROFOAM AND POLYURETHANE-FOAM-IN
990001360 N TEST METHYLENE-CHLORIDE- DICHLOROETHANE- TRICHLOROETHANE- STYFOURAN- POLYURETHANE-FOAM-INSULATION, RAYBEST
990001890 HLOFCFORM, ETHYL-CHLORIDE, DICHLOROETHANE, DICHLOROETHANE, TRICHLOROETHANE POLYMERS, POLYSULFIDE-SEALER, BUNA-
990001890 -CHLORIDE, AND MISC-1,1 DICHLOROETHANE, TRICHLOROETHANE POLYMERS, POLYSULFIDE-SEALER, BUNA-
990005250 SOLVENTS, AND MISC-1,1 DICHLOROETHANE APCI-1A7A-01 1P 2/21/72
990005240 ST-INLESS STEEL ALLOY TO DIN GERMAN NATIONAL STANDARDS COMPOSITION 5-PERCENT-CR 17-PERCENT-NI 4-PERCEN

990001890 YALBE-4, DRILUBE-1, TEFLON DISPERSION-T-FILM, HYDROCARBON-GREASE, HYDRAULIC-OIL, CHLORINATED-BIPHENYL-AROCOLOR-
 990000150 KIZER AND CRYOGENIC LIQUID DISPOSAL APCI-DES-ENG-STD-514.6.2 4P 5/26/61
 990000470 ANT, CRYOGENIC LIQUID, AND DISPOSAL APCI-SAFETY-STD-607.1.20 3P 4/62
 990005510 AGE DRAINAGE AND ULTIMATE DISPOSAL ARRANGEMENTS APCI-II01-1 2P 8/22/71
 990005450 NED GASES CLEANLINESS OF DISPOSAL SYSTEM APCI-II01-1 2P 2/12/72
 990005520 LS AND IGNITION SOURCES IN DISPOSAL SYSTEMS APCI-II02-1 1P 8/22/71
 990005480 APCI OPERATIONAL-HAZARDS- DISPOSAL OF VENTED GASES PROCEDURAL ARRANGEMENTS APCI-II04-1 1P 2/19/72
 990005440 APCI OPERATIONAL-HAZARDS- DISPOSAL OF VENTED GASES COMPANY PRACTICES APCI-II08-1 5P 11/1/71
 990005470 APCI OPERATIONAL-HAZARDS, DISPOSAL OF VENTED GASES CLEANLINESS OF OXYGEN PIPING APCI-II01-2 1P 2/19/72
 990005450 APCI OPERATIONAL-HAZARDS, DISPOSAL OF VENTED GASES CLEANLINESS OF DISPOSAL SYSTEM APCI-II01-1 2P 2/12/72
 990002470 APCI LOX AND LIN VAPOR DISPOSAL-TANK-500-GAL APCI-DRAWING-92483D REV-B 9/30/68
 990002250 E PROGRAM COST-PROCEDURES DIST-OPER-MAN-VOL-4-SECT-6.5 APCI-MEMO-66 10/17/66 2P PLUS SCHEDULE FOR SUBMI
 990000010 KITSON, F.K. APCI DON'T TURN A CYLINDER INTO A RACKET APCI-SAFETY-GRAM-NO-04C 1P 8/7/61
 990000600 BOMBS AND SPARK-IGNITION, DOWN-CORNING FLUORINATED SILICON-OILS, SHELL POLYURETHANE FOAM (EPON-FOAM-H-60) AP
 990001400 40J-SILICONE, PYDRAUL-F-9, DOWN-CORNING-4 COMPOUND SILICONE, SHELL POLYURETHANE FOAM (EPON-FOAM-H-60) AP
 990001400 RNING-4 COMPOUND SILICONE, DOWN-CORNING-4X COMPOUND SILICONE, FAIRBANKS-SILICONE-DC-44, MORSE GREASE, ALPHA-COR
 990000630 NG-RF-1-0065, SILICON-OILS, INDOPOL-POLYBUTENE-OIL AMCCU-L-10, INDOPOL-POLYBUTENE-OIL AM
 990000630 STION TESTING- SILICON-OILS DOWN-CORNING-RF-1-0065, SILICON-OILS DOWN-CORNING-RF-1-0065, INDOPOL-POLYBUTENE-OIL A
 990001890 ICONE, PAINT-ON-GALBESTOS, DOWN-CORNING-SILICONE-PAINT-XP-7-1003, GRIP-CLAD-PRIMER, SHEPWIN-WILLIAMS-E41A4, SUP
 990001890 OPER, PROTECTIVE-COATINGS, DOWN-CORNING-SILICONE, PAINT-ON-GALBESTOS, DOWN-CORNING-SILICONE-PAINT-XP-7-1003, GR
 990005510 AZARDS- SPILLS AND LEAKAGE DRAINAGE AND ULTIMATE DISPOSAL ARRANGEMENTS APCI-II01-1 2P 8/22/71
 990000000 SCHMYER, W.W. APCI DRAIN-LINE EXPLOSION APCI-SAFETY-GRAM-NO-24 2P 1/17/63
 990003080 SCHNYDER, R. APCI MASTER DRAWING 1200-SERIES REGULATIONS APCI-DRAWING-000-0-407004E 1P 3/4/68
 990000680 ANTS, MOLY-SPRAY-KOTE, AND DR1-LUBE APCI-MAR-87-0-8821 1P 4/62
 990001890 ELECTROFILM-SPRAYABLE-A, DRILUBE-1, TEFLON DISPERSION-T-FILM, HYDROCARBON-GREASE, HYDRAULIC-OIL, CHLORINATED
 990000330 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 720-PSIG-MAX CARBON-STEEL APCI-DES-ENG-STD-5
 990000310 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 275-PSIG-MAX CARBON-STEEL APCI-DES-ENG-STD-5
 990000320 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 500-PSIG-MAX-OMG CARBON-STEEL APCI-DES-ENG-5
 990000300 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 150-PSIG-MAX CARBON-STEEL APCI-DES-ENG-5
 990005240 LPHA BRASS-TYPE TCL-100 OK LTD/UK COMPOSITION- COPPER-86-PERCENT ALUM-1.20-PERCENT NIC
 990000750 H-JUT STUDY CELLULUBE-300, DTE 103, RECENT FIRES AT DUPONT-NEW/JOHNSONVILLE-PLANT SOLNUS-500, TITANIUM-TETRACH
 990000740 OUT STUDIES CELLULUBE-300, DTE 103, CELLULUBE-200 RECENT FIRES AT DUPONT-NEW/JOHNSONVILLE-PLANT TITANIUM, TITA
 990004250 RICANTS- KRYTOX-143-AA-OIL DUPONT APCI-IA1A-01 1P 2/21/72
 990004360 RICANTS- KRYTOX-143-AB-OIL DUPONT APCI-IA1A-08 1P 2/21/72
 990004370 RICANTS- KRYTOX-143-AC-OIL DUPONT APCI-IA1A-09 1P 2/21/72
 990004380 RICANTS- KRYTOX-143-AZ-OIL DUPONT APCI-IA1A-10 1P 2/21/72
 990004430 RICANTS- KRYTOX-143-AD-OIL DUPONT APCI-IA1A-15 1P 2/21/72
 990004710 RS, AND ADHESIVES- VITON-A DUPONT APCI-IA4A-06 1P 2/21/72
 990004820 KETS AND PACKINGS- TEFLON, DUPONT APCI-IA5A-10 2P 2/21/72
 990004830 KETS AND PACKINGS- VITON-A DUPONT APCI-IA5A-11 1P 2/21/72
 990000740 LULUBE-200 RECENT FIRES AT DUPONT-NEW/JOHNSONVILLE-PLANT TITANIUM, TITANIUM-DIOXIDE, SOLNUS-500, HYDROCARBON-0
 990000750 DTE 103, RECENT FIRES AT DUPONT-NEW/JOHNSONVILLE-PLANT SOLNUS-500, TITANIUM-TETRACHLORIDE APCI-MAR-87-0-88
 990003100 SKET MATERIALS GARLOCK-900 DURABLE JOHNS-MANVILLE ASBESTOS SHEET PACKING STYLE-61 APCI-MEMO-71 06/2/71
 990001890 E, 3M-DC1252-MARKER-PUTTY, DUFABLE-MANUFACTURING COMPANY-GASKET MATERIAL, JOHNS-MANVILLE-76 GASKET MATERIAL, C
 990001890 UM-CHIPS, MAGNESIUM-SHEET, DYE-PENETRANTS, MAGNUGLO-PASTE10 IN KEFOSENE, TURCU-DYE-CHECK-STEP-2-LIQUID, TURCU
 990001890 YGLU-ZL-22, ZYGLU-ZLX-390, DYE-PROCESS-SOLUTIONS, TURCU-DYE-CHECK PROCESS, ZYGLU-ZE-2-EMULSIFIER, ZYGLU-ZP-5-0
 990004490 BREADING COMPOUNDS- T-FILM ECO MFGR CO APCI-IA2A-03 1P 2/21/72
 990002590 AT GREAT-LAKES-STEEL-CORP ECKURSE-MICHIGAN 2P 6/21/61
 990004670 APCI PLASTICS, AND ADHESIVES- NEOPRENE APCI-IA4A-05 1P 2/21/72
 990004670 APCI PLASTICS, AND ADHESIVES- KEENE-BINDER APCI-IA4A-02 1P 2/21/72
 990004660 APCI PLASTICS, AND ADHESIVES- RTV-60, SILICONE-RUBBER COMPOUND WITH SS-6004-SILICONE-P
 990004720 APCI PLASTICS, AND ADHESIVES- NYLON-66 101 LIL/UN APCI-IA4A-07 1P 2/21/72
 990004690 APCI PLASTICS, AND ADHESIVES- NYLON APCI-IA4A-04 1P 2/21/72
 990004680 APCI PLASTICS, AND ADHESIVES- KUL-F-81 APCI-IA4A-03 1P 2/21/72

990004710 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- VITON-A DUPONT APCI-IA44-06 IP 2/21/72
 990004590 APCI THERMAL AND ELECTRICAL INSULATIONS- FOAMGLAS (CELLULAR-GLASS) INSULATION, PITTSBURGH-CORNING
 990004610 APCI THERMAL AND ELECTRICAL INSULATIONS- GLASS-WOOL APCI-IA3A-03 IP 2/21/72
 990004620 APCI THERMAL AND ELECTRICAL INSULATIONS- MINERAL-WOOL APCI-IA3A-04 IP 2/21/72
 990004640 APCI THERMAL AND ELECTRICAL INSULATIONS- MILFOAM MILFOAM CORP APCI-IA3A-06 IP 2/21/72
 990004650 APCI THERMAL AND ELECTRICAL INSULATIONS- NATIONAL-GYPSUM-BLUE NATIONAL-GYPSUM CORP APCI-IA3A-07
 990004660 APCI THERMAL AND ELECTRICAL INSULATIONS- PERLITE APCI-IA3A-05 IP 2/21/72
 990004600 APCI THERMAL AND ELECTRICAL INSULATIONS- TRANSITE, JOHNS-MANVILLE APCI-IA3A-02 IP 2/21/72
 990001890 DENUM-DISULFIDE, GRAPHITE, ELECTRIFILM-SPRAYABLE-A, DRILUBE-1, TEFLON DISPERSION-T-FILM, HYDROCARBON-GREASE, H
 990003360 OXYGEN COMPRESSION SYSTEM EL/SEGUND/CALIF APCI-CONSTR-SPEC-200.0 TO 200.20 20P 8/7/70
 990000530 SAFETY CONTROL PROCEDURES- EMERGENCY PROCEDURES APCI-SAFETY-STD-626.3.8 8P 5/62
 990003000 M.L. APCI DISCUSSION OF ENERGY RELEASE IN A LIQUID OXYGEN PUMP AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND
 990005990 S ADVANCES IN CRYOGENIC ENGINEERING V-13 P355-565 IIP 1968
 990005530 AZARDS- SPILLS AND LEAKAGE ENVIRONMENTAL WARNINGS AND ESCAPE SYSTEMS APCI-IID3-1 IP 8/22/71
 990000680 DS, AND EXPLOSION TESTING- EPUN-H-60, POLYCEL-40R, AND STYROFOAM, LUBRICANTS, MOLY-SPRAY-KOTE, AND DRI-LUBE
 990000660 PPARATUS, FLORUBE-GREASES, EPOXY COMPOUNDS DEVCON-2-TON AND DEVCON-F, FOAM-TYPE INSULATIONS STYROFOAM AND POLY
 990001890 -SEALER, BUNA-N, NEOPRENE, EPOXY-ADHESIVE, PHENOLIC-MOLDED, MELAMINE-MOLDED, POLYESTER-GLASS, NYLON, MOLYBDENU
 990003120 OMPATABILITY WITH TWO-PART EPOXY-COMPOUND (7343-RESIN- 7139-CATALYST) FROM CREST PRODUCTS CU APCI-IWD-NO
 990002830 IC LIQUIDS AND ASSOCIATED EQUIPMENT APCI-POM-SEC-1.17 8P 4/23/69
 990000770 REQUIREMENTS FOR AIR-PLANT EQUIPMENT APCI-QUAL-CONT-LAYOUT-101F 2P PLUS 5P OF ATTCHMTS 7/1/71
 990002450 OUTSIDE HYDRANT-HOUSE AND EQUIPMENT APCI-SAFETY-STD-630.2.3 3P REV-6/15/70
 990003850 MORE ACCIDENTS ON OXYGEN EQUIPMENT APL-SAFETY-BULL-102 IP 2/8/71
 990004220 AIR PRODUCTS LTD OXYGEN EQUIPMENT APL-SAFETY-DEPT-INFO-SHEET-19 9P
 990000930 LIQUEFIED-GAS PROCESSING EQUIPMENT PENNSALT-TECHNICAL-BULLETIN 6P 2/3/60
 990002850 LEANING-AGENTS, ASSOCIATED EQUIPMENT AND SUPPLIES APPROVED FOR USE IN APCI MANUFACTURING FACILITIES APCI-Q
 990001980 COMPRESSED GAS ASSOC EQUIPMENT CLEANED FOR OXYGEN SERVICE CGA-PAMPHLET-G-4.1 2IP 3/59
 990002840 B3S,M.H. APCI TEST GAUGE EQUIPMENT FAILURE SHAKOPEE APCI-MEMO-68 06/12/68 2P
 990000950 LEANING AND INSPECTION FOR EQUIPMENT IN AIR PLANTS AND IN OXYGEN SERVICE APCI-POM-SEC-1.08 7P PLUS 3P ATTA
 990003070 UTES OF CGA AIR-SEPARATION EQUIPMENT COMMITTEE HELD AT FT/LAUDERDALE FLORIDA 5/11-12/71 LIQUID-OXYGEN PUMP
 990003380 GENERAL CONSTRUCTION AND EQUIPMENT ERECTION OXYGEN COMPRESSION SYSTEM EL/SEGUND/CALIF APCI-CUNSTR-SPEC-
 990005710 L-HAZARDS- OXYGEN-TRANSFER EQUIPMENT MALFUNCTIONS AND FAILURES GAS-PRESSURE-REGULATORS APCI-IIF3A-1 3P 1
 990005700 L-HAZARDS- OXYGEN TRANSFER EQUIPMENT MALFUNCTIONS AND FAILURES COMPRESSORS AND PUMPS APCI-IIF3-4 15P 1/2
 990003180 SMITH,H.W. APCI SAFETY EQUIPMENT NEVER PREVENTS AN ACCIDENT- IT ONLY PREVENTS AN INJURY APCI-SAFETY-GR
 990000960 CHANGER, PLANT, AND PLANT EQUIPMENT SOLVENT WASHOUT-FREQUENCIES APCI-POM-SEC-5.07 3P 7/15/70
 990000550 K. APCI FIRE-PROTECTION EQUIPMENT DELUGE-SYSTEM AND LOX LOADING FACILITY APCI-SAFETY-STD-630.2.6 3P 1
 990002460 H. APCI FIRE PROTECTION EQUIPMENT- INSIDE- OUTSIDE APCI-SAFETY-STD-630.3.2 3P 5/68
 990002450 APCI FIRE PROTECTION EQUIPMENT- OUTSIDE FIRE-HYDRANT APCI-SAFETY-STD-630.2.2 1P 7/26/61
 990003650 SPECIFICATION FOR PIPING ERECTION, TESTING AND CLEANING APL-ENGR-SPEC-M.02 9P PLUS APPENDIX I III III 4/
 990005530 ENVIRONMENTAL WARNINGS AND ESCAPE SYSTEMS APCI-IID3-1 IP 8/22/71
 990004450 APCI LUBRICANTS- ESSO BEACON-325 APCI-IA1A-17 IP 2/21/72
 990001150 APCI TEFLON TAPE PERCENT OTHER EXTRACTABLE CONTAMINANTS AND FLUORESCENCE DAMCO-TEFLON TAPE, SANDEM-INDUSTRIAL
 990001420 ION IN OXYGEN AND SOXHLET ETHER-EXTRACTION GARLOCK-900, KM-226, KM-246 APCI-ANAL-REP-70-013,70-014,70-015
 990001410 TION IN OXYGEN AND SOXHLET ETHER-EXTRACTION MELRATH GARLUCK-900 APCI-ANAL-REP-70-026 APCI-IWG-RU-EA-7027
 990001890 LORIDE, TRICHLOROETHYLENE, ETHYL-ALCOHOL, METHYL-ETHYL-KETONE, KEROSENE, GLYCERINE, POLYETHYLENE-LOW-DENSITY,
 990001890 LENE-CHLORIDE, CHLOROFORM, ETHYL-CHLORIDE, DICHLOROETHANE, DICHLOROETHANE POLYMERS, POLYSULFI
 990000980 EXCHANGER, PLANT, AND PLANT EQUIPMENT WASHOUT-FREQUENCIES APCI-POM-SEC-5
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 990000980 YER,H.W. APCI DRAIN-LINE EXPLOSION APCI-SAFETY-GRAM-NO-24 2P 1/17/63

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 990003640 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- CS2 CARBON-DISULFIDE ALIQUIPPA PUMP-SUCTION-FILTER-DEFROST CYL-S
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 990000690 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- HOUDRY FOAM INSULATION, AND HAVEG GLASS-FIBER-REINFORCED PLASTIC
 990000660 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- IGNITION TEST-APPARATUS, FLOKUBE-GREASES, EPOXY COMPOUNDS DEVCON
 990000620 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- PINE AND MAPLE WOOD, ACTIVATED CARBON APCI-MAP-87-0-8821 1P
 990000670 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- POLYESTER RESIN IMPREGNATED FIBERGLASS LAVA APCI-MAR-87-0-882
 990000630 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- SILICON-OILS JDM-CORNING-RF-1-0065, SILICON-OILS DGM-CORNING-RF-
 990000610 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- SPARK-IGNITION, STANDARD BOMB TEST, LED-PLATE-251, PIPE-DOPE A
 990000650 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- STANDARD PRESSURE BOMBS AND SPARK-IGNITION, DGM-CORNING FLUORINA
 990000640 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- STANDARD IGNITION TEST METHOD, APL PIPING-RESIDUE, METHYLENE-CHL
 990000700 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- TALCUM-POWDER AS A LUBRICANT, TAKSET, PLASITE APCI-MAR-87-0-88
 990000590 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- UIC-1 6P 11/17/71 APCI-MAR-87-0-8820 1P 4/61
 990003750 APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- UIC-1 6P 11/17/71 APCI-MAR-87-0-8820 1P 4/61
 990002580 APCI LOX-PUMP FIRES AND EXPLOSIONS APCI-MEMO-70 06/26/70 3P
 990001150 TEFLON TAPE PERCENT ETHER EXTRACTABLE CONTAMINANTS AND FLUORESCENCE DAMCO-TEFLON TAPE, SANDEM-INDUSTRIAL, CRA
 990003160 NREL-PROTECTIVE-EQUIPMENT- EYE PROTECTION APCI-SAFETY-STD-627.4.2 5P 10/62
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 990000110 E.P.M.W. APCI VACUUM PUMP FAILURES APCI-SAFETY-GRAM-NO-35 1P 10/4/63
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 990003680 N-TRANSFER MALFUNCTION AND FAILURES APCI INCIDENTS INVOLVING OXYGEN-TRANSFER-EQUIPMENT OR INSTRUMENTATION AP
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 990003490 GRINNELL CO DEFECTS AND FAILURES IN PRESSURE-VESSELS AND PIPING REINOLD PUBLISHING CORP 427P 1965
 990005740 -TRANSFER MALFUNCTIONS AND FAILURES INSULATION SYSTEM DUE TO VIBRATIONS DETEIORATION APCI-IIF3C-1 1P 12
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 990001400 NING-4X COMPOUND-SILICONE, FAIRBANKS-SILICONE-DC-44, MORSE GREASE, ALPHA-CORP-POLYKETE-MICROSIZE, MONSANTO-PYD
 990002160 ROBERTS, F. LEHIGH UNIV FATIGUE CRACK GROWTH-RATES AND FRACTURE TOUGHNESS STUDY OF WELDED ALUMINUM ALLOY-5
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 990000400 CLO-INSULATION AND MINERAL FIBER GRANULATED APCI-DES-ENG-STD-581.2 2P 6/26/69
 990000670 LYE/STER RESIN IMPREGNATED FIBERGLASS LAVA APCI-MAR-87-0-8821 1P 3/62
 990001310 U ESTABLISH ACCEPTANCE OF FIBERIZED MINERAL WOOL INSULATION APCI-QUAL-CJMT-LAYOUT-103L 2P 7/1/71
 990002050 RYLAND CASUALTY CO APCI FIELD INSPECTION CONTRACT WITH MARYLAND CASUALTY CO APCI-POM-SEC-6.09-ATTCHMT-1
 990005580 TRANSFER SYSTEMS SYSTEMS- FIELD FABRICATED CRYOGENIC LIQUID STORAGE TANKS APCI-IIFI-3 1P 2/3/72
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 990004270 AZARD LEVEL OF HYDROCARBON FILMS IN OXYGEN SYSTEMS APCI-DEPT-INFO-SHEET-41 2P 4/8/71
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 990001990 AZARD LEVEL OF HYDROCARBON FILMS IN SYSTEMS CONTAINING LIQUID AND GASEOUS OXYGEN ADVANCES IN CRYOGENIC
 990002000 ZARD LEVEL OF HYDROCARBON FILMS IN OXYGEN SYSTEMS AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLAN
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 990002990 R GAS CO OXYGEN TRAILER PIKE AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-4 PP49-50 19
 990002660 APCI OXYGEN COMPRESSOR FIRE APCI-SAFETY-GRAM-NO-03 2P 7/7/61
 990004210 PUMP EXPLOSION AND TANKER FIRE AT SHEEPBRIDGE ALLOY CASTINGS LTD APL-MEMO-64 02/5/64 16P
 990003860 ROCKHARDT OXYGEN COMPRESSOR FIRE AT SSPC ROGNAC PLANT 3/2/71 APL-SAFETY-BULL-107 3P 4/14/71
 990003920 SON,I. APL EXPLOSION AND FIRE DUE TO THE CRYOSTAR-GB114 LUX-PUMP ON AN SSPC LOX-TANKER APL-SAFETY-DEPT-RE
 990001090 SON,K.J. EVERSON,I. APL FIRE HAZARD WHEN VAPOUR CLEANING WITH TRICHLOROETHYLENE (T.C.E.) APL-SAFETY-DEPT
 990004260 UPON THE HUMAN ASPECTS OF FIRE IN ARTIFICIAL GAS ENVIRONMENTS FPRC/L270 28P 9/67
 990002590 A.G. LINDE ACCIDENT AND FIRE IN OXYGEN GENERATING PLANT AT GREAT-LAKES-STEEL-CORP ECORSE-MICHIGAN 2P 6/
 990000020 APCI KITSON,F.K. FIRE IN OXYGEN-LINE APCI-SAFETY-GRAM-NO-05 1P 10/20/61
 990003820 GAYLE,J.B. NASA-KENNEDY APL FIRE IN OXYGEN-LINE APL-SAFETY-BULL-028 1P 1/68
 990001970 APCI FLEET SAFETY- FIRE INCIDENT IN AN OXYGEN CLOUD FIRE JOURNAL PP70-8 AND 81 4P 1/71
 990005330 TIBILITY, QUALITY-CONTROL, EVERSON,I. APL FIRE EXTINGUISHMENT APCI-SAFETY-STD-635.30 5P 2/68
 990004230 HUBBS,M.H. APL FIRE HAZARDS APCI-IBID(1)-1 2P 9/9/71
 990002460 ENGLAND ASSESSMENT OF THE FIRE HAZARDS IN COMPRESSED-AIR AND OXYGEN RICH ENVIRONMENTS APL-SAFETY-DEPT-IN
 990002490 SMITH,H. APCI FIRE PROTECTION EQUIPMENT- INSIDE- OUTSIDE APCI-SAFETY-STD-630.3.2 3P 5/68
 990002440 HUBBS,M.H. APCI FIRE PROTECTION EQUIPMENT- OUTSIDE HYDRANT-HOUSE AND EQUIPMENT APCI-SAFETY-STD-6
 990004240 ENGLAND ASSESSMENT OF THE FIRE RISKS OF THE OXYGEN ENVIRONMENT EXPERIMENTS FPRC/MEMO-Z17 24P 1/65
 990003880 HUBBS,M.H. APCI FIRE OCCURRED IN BURCKHARDT CENTRIFUGAL LOX-PUMP-TYPE-GB114-NO-29224 APL-SAFETY-D
 990004250 ARNBOROUGH HANTS ENGLAND FIRE RISKS TO MAN OF OXYGEN RICH GAS ENVIRONMENTS FPRC/MEMO-223 12P 7/65
 990002690 GENER,W. WINDGASSEN,K.F. FIRE TESTS ON CENTRIFUGAL PUMPS FOR LIQUID-OXYGEN CRYOGENICS V-10 PP241-248 8P
 990005300 LITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CONTROL-APL APCI-IBID(2)-2 2P 2/21/72
 990005320 LITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, CLEANING-PROCEDURES-APL APCI-IBIC-02 1P 2/21/72
 990005310 LITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, CLEANING-PROCEDURES-APL APCI-IBIC-01 14P 2/21/72
 990005340 LITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CONTROL-APCI APCI-IBID(2)-1 3P 9/9/71
 990005350 LITY, COMPATIBILITY CHECK, FIRE-COMPATIBILITY, QUALITY-CONTROL, FIRE HAZARDS APCI-IBID(1)-1 2P 9/9/71
 990003310 I MAINTENANCE OF PORTABLE FIRE-EXTINGUISHERS APCI-POM-SEC-1.13 5P 3/30/67
 990002440 TECTICN EQUIPMENT- OUTSIDE FIRE-HYDRANT APCI-SAFETY-STD-630.2.2 1P 7/26/61
 990000950 KITSON,F.K. APCI FIRE-PROTECTION EQUIPMENT- DELUGE-SYSTEM AND LOX LOADING FACILITY APCI-SAFETY-ST
 990001400 APCI INVESTIGATION OF THE FIRE-RESISTANT QUALITIES OF CELLULOSE-220, CELLULOSE-150, UCON-LB283, UCON-LB550, U

990005750 APCI OPERATIONAL-HAZARDS- FIRES AND EXPLOSIONS APCI-IIG-1 6P 11/1/71
 990002580 TTINI, B.J. APCI LOX-PUMP FIRES AND EXPLOSIONS APCI-MEMO-70 06/26/70 3P
 990000740 -103, CELLULUBE-200 RECENT FIRES AT DUPONT-NEW/JOHNSONVILLE-PLANT TITANIUM, TITANIUM-DIOXIDE, SOLNUS-500, HYDR
 990000750 ULUBE-300, DTE 103, RECENT FIRES AT DUPONT-NEW/JOHNSONVILLE-PLANT SOLNUS-500, TITANIUM-TETRACHLORIDE APCI-MA
 990003910 PL INVESTIGATION OF VALVE FIRES AT TEXAS INSTRUMENTS LTO-BEUFORD APL-SAFETY-DEPT-REP-31 5P REV-1 2/11/
 990001020 G OF CARBON STEEL PIPE AND FITTINGS, CLEANING ALUMINUM-PIPE FITTINGS PARTS AND FABRICATIONS, CLEANING STAINL
 990000750 WALDE, F.A. APCI FLAMMABILITY AND EXPLOSION HAZARDS- PLANT-WASH-OUT STUDY CELLULUBE-300, DTE 103, RE
 990000750 WALDE, F.A. APCI FLAMMABILITY AND EXPLOSION HAZARDS- KEL-F-POLYMER, NYLON, CUTTING-OILS APCI-MAR-8
 990000750 WALDE, F.A. APCI FLAMMABILITY AND EXPLOSION HAZARDS- PLANT-WASH-OUT STUDIES CELLULUBE-300, DTE-103,
 990000750 WALDE, F.A. APCI FLAMMABILITY AND EXPLOSION HAZARDS- HALOCARBON, MOLYBDENE-99, MOLYBDATE-TYPES-2 AND
 990000750 WALDE, F.A. APCI FLAMMABILITY AND EXPLOSION HAZARDS- OXYGEN-PRESSURE-GAUGE IMF WOOL, SPINTEX-305, MG
 990001300 APCI SEALING MATERIALS- FLAMMABILITY IN 100-PERCENT GASEOUS OXYGEN FOAMSEAL-30-45-LIQUID, FOAMSEAL-30-45
 990001210 SAFETY-VALVE-SEAT OXIDAT FLAMMABILITY IN 100-PERCENT GASEOUS OXYGEN APCI-ANAL-REP-61-435 APCI-IWO-NO-1
 990001350 DER, L. APCI FLURO-GLIDE FLAMMABILITY IN 100-PERCENT GASEOUS OXYGEN APCI-ANAL-REP-61-262 IP 4/11/61
 990001460 KITSON, F.K. APCI FLAMMABILITY TEMPERATURE APCI-MEMO-59 12/11/59 IP
 990002930 SCHMAUCH, G.E. APCI FLAMMABILITY TEST OF GASKETS IN OXYGEN ATMOSPHERES JOHN-DURE-CO, MELKATH-GASKET-C
 990001970 APCI FLEET SAFETY- FIRE EXTINGUISHMENT APCI-SAFETY-STD-635.30 5P 2/68
 990001940 APCI FLEET SAFETY- LOADING AND UNLOADING OPERATIONS APCI-SAFETY-STD-635.19 6P 2/68
 990001300 DRY, FLEXFAS-82-10-LIQUID, FOAMSEAL-30-45-DRY, FLEXFAS-82-10-LIQUID, SEALFAS-MASTIC-31-97-DRY, PITTSEAL-
 990001300 LIQUID, FOAMSEAL-30-45-DRY, PEGRAM, J.W. APL FLEXFAS-82-10-LIQUID, FLEXFAS-82-10-DRY, SEALFAS-MASTIC-31-97-LIQUID, SEALFAS-MASTI
 990003760 FLEXIBLE HOSES FOR CHARGING AND DISCHARGING MANIFOLDS OXYGEN SERVICE APL-ENGR-
 990001110 - IGNITION TEST-APPARATUS, FLOOR TREATMENT WEST CHEMICAL PRODUCTS INC, ALUMINUM-OXIDE, SEAM COMPOUND GEON PD
 990002730 MASTER, H.H. APCI OXYGEN FLOW-METER RING SEAL-FLUID APCI-MEMO-70 02/27/70 IP
 990001150 TRACTABLE CONTAMINANTS AND FLUORESCENCE DAMCO-TEFLON TAPE, SANDEM-INDUSTRIAL, CRANE PACKING CO APCI-ANAL-R
 990003110 L.C. LATSHAW, D.R. APCI FLUORESCENCE OF VARIOUS TYPES OF OILS- MUBIL-DIE-105 TEXACO-CAPPELLA-AA CELLULUBE-5
 990001890 UPLENE VITON A VINYLIDEN FLUORIDE, POLYDIMETHYLSILOXANE, FLUORINATED-SILOXANE, LS-53, BUTYL-RUBBER, IRON-OXI
 990000900 PARK-IGNITION, DOW-COKNING FLUORINATED SILICON-OILS, SHELL POLYURETHANE FOAM (EPUN-FOAM-H-60) APCI-MAR-87-0-
 990001890 IDE, POLYDIMETHYLSILOXANE, FLUORINATED-SILOXANE, LS-53, BUTYL-KUBBER, IRON-OXIDES, TALC, ASBESTOS, ALUMINUM-CH
 990001130 COMPATIBILITY OF CROSSLITE FLUOROCARBON TAPE THREE-M-FLUOROCARBON-TAPE, PERMACEL-TAPE APCI-MEMO-63 07/30/63
 990004570 READING COMPOUNDS- THREE-M FLUOROCARBON-TAPE APCI-IA2A-11 2P 2/21/72
 990001460 RGT-GASKET-CO LOX TRANSFER FLUROGREEN-E-600 APCI-MEMO-70 10/23/70 IP
 990004760 PCI GASKETS AND PACKINGS FLUROGREEN-E-600, JOHN/DURE CO APCI-IA5A-04 IP 2/21/71
 990001390 YUDER, L. APCI FLURO-GLIDE FLAMMABILITY IN 100-PERCENT GASEOUS OXYGEN APCI-ANAL-REP-61-262
 990004420 APCI LUBRICANTS- FLURO-GLIDE, CHEMPLAST INC APCI-IA1A-14 IP 2/21/72
 990003110 -CAPPELLA-AA CELLULUBE-550 FLUROGLUBE SEARS-THREAU-CUTTING-OIL APCI-ANAL-REP IP 7/15/71
 990001400 UCON-HB660, AURALUBE-F5, FLUROGLUBE-F55, KEL-F-LF3, VERSILUBE-F-50, SF81(40)-SILICONE, PYDRAUL-F-9, DOW-CCRN
 990004390 APCI LUBRICANTS- FLUROGLUBE, FS-5, HOOKER CHEMICAL APCI-IA1A-11 IP 2/21/72
 990004350 APCI LUBRICANTS- FLUROGLUBE, FS, HOOKER CHEMICAL APCI-IA1A-07 IP 2/21/72
 990001300 POROUS-INSULATING-MATERIAL FOAM GLASS APCI-ANAL-REP-61-034 TO 61-40 AND 61-42 APCI-IWO-NO-10-0589 IP 2
 990000890 EXPLOSION TESTING- HOUDRY FOAM INSULATION, AND HAVEG GLASS-FIBER-REINFORCED PLASTIC APCI-MAR-87-0-8821 IP
 990000600 N-OILS, SHELL POLYURETHANE FOAM (EPCN-FOAM-H-60) APCI-MAR-87-0-8820 IP 8/61
 990004590 D ELECTRICAL INSULATIONS- FOAMGLAS (CELLULAR-GLASS) INSULATION, PITTSBURGH-CURNING CORP APCI-IA3A-01 IP
 990002930 M NATIONAL-GYPSUM (GREEN) FOAM-GLAS (CORNING) APCI-IWO-NO-LA-0333 APCI-MEMO-68 10/24/68 2P
 990002920 AL-GYPSUM-BLUE LOX-SYSTEMS FOAM-GLASS LIQUID-HYDROGEN-PIPING-SYSTEMS LNG-SYSTEMS INERT-CRYOGENES BELOW THE DE
 990000860 DEVCON-2-TON AND DEVCON-F, FGAM-TYPE INSULATIONS STYROFOAM AND POLYURETHANE-FOAM-INSULATION, RAYBFSTOS-MANHATT
 990001300 EN FOAMSEAL-30-45-LIQUID, FOAMSEAL-30-45-DRY, FLEXFAS-82-10-LIQUID, FLEXFAS-82-10-DRY, SEALFAS-MASTIC-31-97-L
 990000460 O-PERCENT GASEOUS OXYGEN FORMSEAL-30-45-LIQUID, FOAMSEAL-30-45-DRY, FLEXFAS-82-10-LIQUID, FLEXFAS-82-10-DRY,
 990000460 APCI LUBRICANTS- FORMBLIN-Y04 MONTECATINI-EDISON APCI-IA1A-18 IP 2/21/72
 990000730 S-Z AND X-15, CABUSIL-M-5 FURMICA-LAMINATE BONDED WITH A PHENOLIC RESIN, CUTTING-OILS, HEXADECANE, HYDROCARB
 990002160 UE CRACK GROWTH-RATES AND FRACTURE TOUGHNESS STUDY OF WELDED ALUMINUM ALLOY-5083 ASME WINTER ANNUAL-MEETI

990002150 A.J. ESSO APPLICATION OF FRACTURE-MECHANICS TO SAFE-LIFE DESIGN IN CRYOGENIC PRESSURE-VESSELS ESSO-REPORT
 990005100 S, AND SURFACE TREATMENTS- FREE-MACHING BRASS APCI-IA6A-24 2P 2/21/72
 990001160 NO SEALER- TAPE-SEAL FROM FRIESLAND-PLASTIC COMPANY, PERMACEL-TAPE APCI-ANAL-REP-60-495,61-3 APCI-IWO-NO-
 990004390 I LUBRICANTS- FLUOROLUBE, FS-5, HOOKER CHEMICAL APCI-IAIA-11 IP 2/21/72
 990004350 I LUBRICANTS- FLUOROLUBE, FS, HOOKER CHEMICAL APCI-IAIA-07 IP 2/21/72
 990003070 IPMENT COMMITTEE HELD AT FT/LAUDERDALE FLORIDA 5/11-12/71 LIQUID-OXYGEN PUMPS ALUMINUM IN OXYGEN SERVICE L
 990004750 ASBESTOS GASKET MATERIAL) GARLOCK MFG CO APCI-IA5A-07 IP 2/21/72
 990001410 T ETHER-EXTRACTION MELKATH GARLOCK-900 APCI-ANAL-REP-70-026 APCI-IWO-NO-EA-7027 2P 1/30/70
 990003090 HEET PACKING STYLE-NO-61 GARLOCK-900 APCI-IWO-NO-LB-0795 APCI-ANAL-REP-71-264 2P 5/28/71
 990003100 DMPATIBLE GASKET MATERIALS GARLOCK-900 DURABLA JOHNS-MANVILLE ASBESTOS SHEET PACKING STYLE-61 APCI-MEMO-7
 990004790 PCI GASKETS AND PACKINGS- GARLOCK-900 (SHEET-ASBESTOS GASKET MATERIAL) GARLOCK MFG CO APCI-IA5A-07 IP
 990003040 (GREEN) VITON-A (BLACK) GARLOCK-900 JOHNS-MANVILLE ASBESTOS-61 SHEET APCI-ANAL-REP-71-344 AND APCI-A
 990001420 D SOXHLET ETHER-EXTRACTION GARLOCK-900, KM-226, KM-246 APCI-ANAL-REP-70-013,70-014,70-015 APCI-123 APCI-A
 990002420 D OPERATION OF OXYGEN-FUEL GAS SYSTEMS FOR WELDING AND CUTTING NFPA-NO-51 8P 1969 AND CUTTING AND WELDI
 990003500 DF MECHANICAL ENGINEERS GAS TRANSMISSION AND DISTRIBUTION PIPING SYSTEMS ANSI-B31.8 108P 1968
 990003590 DERAL SAFETY-STANDARDS FOR GAS PIPELINES CORROSION-PITTING- NOTICE OF PUBLIC HEARING FEDERAL REGISTER VOL
 990001920 IREMENTS FOR CUSTOMER BULK GAS SUPPLY SYSTEM APCI-DIST-OPER-MAN-V-1-SEC-4.1.3 2P 6/71
 990000070 SCHACHTER, W. W. APCI GASEOUS OXYGEN APCI-SAFETY-GRAM-NO-23C 6P 1/10/63
 990001170 WALDE, R. A. APCI GASEOUS OXYGEN COMPATIBILITY TEST ON MOLY-LUBE-NU-99 APCI-MEMO-63 06/11/63 IP
 990001130 WALDE, R. A. APCI GASEOUS OXYGEN COMPATIBILITY OF CROSSLITE FLUOROCARBON TAPE THREE-M-FLUOROCARBON-TA
 990005970 ATERIALS COMPATIBILITY FOR GASEOUS OXYGEN SYSTEMS MAB-3268-69 9P 11/5/69
 990000160 APCI PRESSURE-VESSELS- GASEOUS OXYGEN STORAGE CYLINDER APCI-DE-ENG-STD-515.1.3 3P 10/17/60
 990005710 MALFUNCTIONS AND FAILURES GAS-PRESSURE-REGULATORS APCI-IIF3A-1 3P 12/10/71
 990001370 TESTS WITH SILICONE-RUBBER GASKET COMPOUND- RTV-60-NP-134372-R235 APCI-R+D-NOTEBOOK-111 P149 IP 1/63
 990001410 LATSCH, D. R. APCI GASKET MATERIAL COMPATIBILITY OF MELKATH MATERIAL WITH OXYGEN COMBUSTION IN OXYGEN
 990001420 LATSCH, D. R. APCI GASKET MATERIALS COMPATIBILITY OF GASKET MATERIALS WITH OXYGEN COMBUSTION IN OXYG
 990003100 APCI LUX CUMPTIBLE GASKET MATERIALS GARLOCK-900 DURABLA JOHNS-MANVILLE ASBESTOS SHEET PACKING STYLE
 990001390 ATERIAL, JOHNS-MANVILLE-76 GASKET MATERIAL, CLOTH-ASBESTOS, GLASS-COTTON-ALUMINIZED-MIL-C-8240, COCOTITE-CERAM
 990004760 APCI GASKETS AND PACKINGS- FLUOROGREEN-E-600, JOHN/DORE CO APCI-IA5A-04 IP 2/21/71
 990004790 APCI GASKETS AND PACKINGS- GARLOCK-900 (SHEET-ASBESTOS GASKET MATERIAL) GARLOCK MFG
 990004730 APCI GASKETS AND PACKINGS- GRAPHITE-IMPREGNATED-ASBESTOS-PACKING APCI-IA5A-01 IP 2/2
 990004857 APCI GASKETS AND PACKINGS- KLINGERIT-661 RICHARD KLINGER LTD/UK
 990004780 APCI GASKETS AND PACKINGS- KM226-SHEET ASBESTOS GASKET MATERIAL NICOLET INDUSTRIES INC
 990004810 APCI GASKETS AND PACKINGS- KM246 SHEET-ASBESTOS GASKET MATERIAL NICOLET INDUSTRIES A
 990004770 APCI GASKETS AND PACKINGS- MELKATH-150 (SHEET-ASBESTOS GASKET MATERIAL) APCI-IA5A-05
 990004840 APCI GASKETS AND PACKINGS- SINDANYO CS-31-ASBESTOS AND CEMENT BOARDS, NATURAL-UNTREATE
 990004820 APCI GASKETS AND PACKINGS- TEFLO, DUPONT APCI-IA5A-10 2P 2/21/72
 990004740 APCI GASKETS AND PACKINGS- TFE-GF-GREEN, MELKATH GASKETS CO APCI-IA5A-02 IP 2/21/7
 990004860 APCI GASKETS AND PACKINGS- TYGAFLOUR CEMENTABLE PIPE TAPES TYGADURE LTD/UK APCI-IA5
 990004750 APCI GASKETS AND PACKINGS- VALLEGREEN, VALLEY/FORGE GASKET CO APCI-IA5A-03 IP 2/21
 990004830 APCI GASKETS AND PACKINGS- VITON-A DUPONT APCI-IA5A-11 IP 2/21/72
 990004800 APCI GASKETS AND PACKINGS- VULCANIZED-RED-FIRRE-GASKETS APCI-IA5A-08 IP 2/21/72
 990001460 APCI FLAMMABILITY TEST OF GASKETS IN OXYGEN ATMOSPHERES JOHN-DORE-CO, MELKATH-GASKET-CO, VALLEY-FORGE-GASKE
 990002840 HUBBS, M. H. APCI TEST GAUGE EQUIPMENT FAILURE SHAKOPEE APCI-MEMO-68 06/12/68 2P
 990000120 RUYER, W. W. APCI PRESSURE GAUGE FAILURES APCI-SAFETY-GRAM-NO-43 2P 5/8/64
 990002970 W. W. APCI SPECIALTY-GAS GAUGE-FAILURE APCI-MEMO-64 04/13/64 4P
 990000780 ENTS FOR BOURDON-TUBE TYPE GAUGES USED FOR OXYGEN SERVICE APCI-QUAL-CUNT-LAYOUT-102F 3P 7/1/71
 990004860 TH SS-4004-SILICONE-PRIMER GE THERMOLITE-12-CURING-CATALYST APCI-IA4A-01 IP 2/21/72
 990005730 MALFUNCTIONS AND FAILURES GEISERING, EXCESSIVE VIBRATIONS, SHOCK (THERMAL AND PRESSURE), LINE-SURGES APCI
 990001110 MANG-OXIDE, SEAM COMPOUND GEUR. POLYVINYLCHLORIDE, PLASTIC LEAD SEAL-NO-2-JOHN CRANE APCI-MEMO-59 01/28/59
 990005220 INLUSH-STEEL ALLOY TO DIN GERMAN NATIONAL STANDARDS COMPOSITION 5-PERCENT-CR 17-PERCENT-NI 4-PERCENT-CU
 990005980 MERKBLATTER GERMAN PRESSURE VESSEL CODE-AD MEKBLATTER? (ENGLISH TRANSLATION) 304P 9/71
 990001300 S-INSULATING-MATERIAL FOAM GLASS APCI-ANAL-REP-61-034 TO 61-40 AND 61-42 APCI-IWO-NO-10-0589 IP 2/3/61
 990000410 GLED-BOXES, THERMAL TANKS, GLASS WOOL APCI-DES-ENG-STD-581.3 IP 10/24/60

990003170 SSURE-GAUGE FAILURE SAFETY GLASSES SAVE ANOTHER PAIR OF EYES APCI-SAFETY-GRAY-NU-01 IP 6/1/61
 990001890 MATERIAL, CLOTH-ASBESTOS, GLASS-COTTON-ALUMINIZED-MIL-C-8240, COCOTITE-CEP-AMIC-INSULATION, CHROMATE-DYED-GLAS
 990000890 FCAP INSULATION, AND HAVG CLASS-FIBER-REINFORCED PLASTIC APCI-MAR-87-0-8821 IP 6/62
 990004610 D ELECTRICAL INSULATIONS CLASS-WOOL APCI-IA3A-03 IP 2/21/72
 990001890 YL-ETHYL-KEITUNE, KEROSENE, GLYCERINE, POLYETHYLENE-LW-DENSITY, POLYETHYLENE-IRRADIATED, POLYVINYLCHLORIDE, PC
 990002770 HOSE-CONNECTOR ACCIDENT-GRANITE/CITY APCI-MEMO-67 12/15/67 IP
 990002780 APCI NEAR-MISS ACCIDENT-FACILITY APCI-MEMO-67 12/15/67 IP
 990000400 SULATION AND MINERAL FIBER GRANULATED APCI-DES-ENG-STD-581.2 2P 6/26/69
 990001440 BLE CONTAMINANT CONTENT IN GRAPHITE IMPREGNATED ASBESTOS-PACKING TEFLON COATED ASBESTOS-BLUE APCI-MEMO-60
 990001890 TED-BIPHENYL-AROCLOL-1254, GRAPHITE-CHLOR-BIPHENYL, VINYL-CHLORIDE, CIS-DICHLOROFETHYLENE, TRANS-DICHLOROEHTHYLE
 990004730 PCI GASKETS AND PACKINGS GRAPHITE-IMPREGNATED-ASBESTOS-PACKING APCI-IA5A-01 IP 2/21/72
 990001890 LON, MOLYBDENUM-DISULFIDE, GRAPHITE, ELECTROFILM-SPKAYABLE-A, DRILUBE-1, TEFLON DISPERSION-T-FILM, HYDROCARBON
 990001400 ANKS-SILICONE-OC-44, MORSE GREASE, ALPHA-CORP-MOLYKOTE-MICROSIZ, MONSANTO-PYDRAUL, GULF-MECHANISM-HYDROCARBON
 990002590 XYGEN GENERATING PLANT AT GREAT-LAKES-STEEL-CORP ECORSE-MICHIGAN 2P 6/21/61
 990001890 -SILICONE-PAINT-XP-7-1003, GRIP-CLAD-PRIMER, SHERWIN-WILLIAMS-E41A4, SUPERFLAKE-1822, SUPERIOR-GRAPHITE-CO, CA
 990001290 METALLIC MATERIALS DESIGN GUIDELINES AND TEST DATA-HANDBOOK MSC-02681 380P 5/29/70
 990001400 CRUSIZE, MONSANTO-PYDRAUL, GULF-MECHANISM-HYDROCARBON, HAVOLINE-HO-HYDROCARBON, SHELL-2-1176-A-HYDROCARBON, IN
 990004310 ICANTS- HALOCARBON-11-14E, HALOCARBON PRODUCTS CORP APCI-IA1A-03 IP 2/21/72
 990004340 - HALOCARBON-25-55-GREASE, HALOCARBON PRODUCTS CORP APCI-IA1A-06 IP 2/21/72
 990004300 ICANTS- HALOCARBON-11-21E, HALOCARBON PRODUCTS CORP APCI-IA1A-02 IP 2/21/72
 990004320 ANTS- HALOCARBON-6-25-WAX, HALOCARBON PRODUCTS CORP APCI-IA1A-04 IP 2/21/72
 990004310 APCI LUBRICANTS- HALOCARBON-11-14E, HALOCARBON PRODUCTS CORP APCI-IA1A-03 IP 2/21/72
 990004300 APCI LUBRICANTS- HALOCARBON-11-21E, HALOCARBON PRODUCTS CORP APCI-IA1A-02 IP 2/21/72
 990004340 APCI LUBRICANTS- HALOCARBON-25-55-GREASE, HALOCARBON PRODUCTS CORP APCI-IA1A-06 IP 2/21/72
 990004320 APCI LUBRICANTS- HALOCARBON-6-25-WAX, HALOCARBON PRODUCTS CORP APCI-IA1A-04 IP 2/21/72
 990001380 SCHMAYER, W.W. APCI HALOCARBON-WAX-6-25 APCI-MEMO-69 02/6/69 IP
 990000730 ITY AND EXPLOSION HAZARDS- HALOCARBON, MOLYKOTE-TYPES-2 AND X-15, CABOSIL-M-5 FORMICA-LAMINATE
 990001830 APCI PIPING- INTRODUCTION HAND VALVE-CODE APCI-DES-ENG-STD-579.3 12P 1/63
 990004240 ION MEDICINE FARNBOROUGH HANTS ENGLAND ASSESSMENT OF THE FIRE RISKS OF THE OXYGEN ENVIRONMENT EXPERIME
 990004250 ION MEDICINE FARNBOROUGH HANTS ENGLAND FIRE RISKS TO MAN OF OXYGEN RICH GAS ENVIRONMENTS FPRC/MEMO-2
 990004260 ION MEDICINE FARNBOROUGH HANTS ENGLAND FURTHER STUDIES UPON THE HUMAN ASPECTS OF FIRE IN ARTIFICIAL GAS
 990003200 EQUIPMENT- WEARING APPAREL HARD HATS APCI-SAFETY-STD-627.4.1 IP 6/15/70
 990004100 OXYGEN COMPRESSOR MANUAL HATTINGEN PLANT 15P APPENDIX I II III 8P
 990000690 JUDRY FOAM INSULATION, AND HAVG GLASS-FIBER-REINFORCED PLASTIC APCI-MAR-87-0-8821 IP 6/62
 990001400 ULF-MECHANISM-HYDROCARBON, HAVOLINE-HO-HYDROCARBON, SHELL-2-1176-A-HYDROCARBON, INDUOIL CHEMICAL INDOPOL-I-10-P
 990002000 BALLY, L. APCI HAZARD LEVEL OF HYDROCARBON FILMS IN OXYGEN SYSTEMS AICHE-CEP-TECH-MANUAL SAFE
 990003030 KEHAT, E. APCI HAZARD LEVEL OF HYDROCARBON FILMS IN SYSTEMS CONTAINING LIQUID AND GASEOUS OXYGE
 990001990 KEHAT, E. APCI HAZARD LEVEL OF HYDROCARBON FILMS IN SYSTEMS CONTAINING LIQUID AND GASEOUS OXYG
 990004270 EVERSON, I. APCI HAZARD WHEN VAPOUR CLEANING WITH TRICHLOROETHYLENE (T.C.E.) APL-SAFETY-DEPT-INFO
 990000360 TESTING CYLINDERS HAS ITS HAZARDS APCI-SAFETY-GRAM-NU-49 2P 3/26/65
 990005900 APCI SYSTEM-EMERGENCIES HAZARDS PROTECTION APL-BULLETS AND REPORTS ON VARIOUS PROBLEMS RELATED TO OXYGE
 990005890 APCI SYSTEM-EMERGENCIES HAZARDS PROTECTION GENERAL PRECAUTIONS APCI-IVE-1 2P 11/8/71
 990000730 FLAMMABILITY AND EXPLOSION HAZARDS- HALOCARBON, MOLYKOTE-TYPES-2 AND X-15, CABOSIL-M-5 FORMICA-L
 990000720 FLAMMABILITY AND EXPLOSION HAZARDS- KEL-F-POLYMER, NYLON, CUTTING-DILLS APCI-MAR-87-0-8822 IP 5/63
 990000710 FLAMMABILITY AND EXPLOSION HAZARDS- OXYGEN-PRESSURE-GAUGE TWF WOOL, SPINTEX-305, MOLYKOTE-TYPE-2 AND TYPE-X-1
 990000740 FLAMMABILITY AND EXPLOSION HAZARDS- PLANT-WASH-OUT STUDIES CELLULUBE-300, DTE-103, CELLULUBE-200 RECENT FIRES
 990000760 FLAMMABILITY AND EXPLOSION HAZARDS- PLANT-WASH-OUT STUDIES CELLULUBE-300, DTE-103, RECENT FIRES AT DUPONT-NEW/JC
 990000750 FLAMMABILITY AND EXPLOSION HAZARDS- PLANT-WASH-OUT STUDY CELLULUBE-300, DTE 103, RECENT FIRES AT DUPONT-NEW/JC
 990002510 H.H. APCI PRODUCT VAPOR SAFETY INFORMATION RELATIVE TO LIQUID-VAPOR-CLOUDS APCI-PAPER 7P 1971
 990000670 KEHAT, E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- SILICON-DILS DOW-CURNING-REF-1-0065, SILICON-DILS DO
 990000610 KEHAT, E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- SPARK-IGNITION, STANDARD BOMB TEST, LED-PLATE-251,
 990000390 KEHAT, E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- UCON-TYPE LUBRICANTS, STEEL-PIPES APCI-MAR-87-0-8
 990000600 KEHAT, E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- STANDARD PRESSURE BOMBS AND SPARK-IGNITION, DOW-COR

990000640 KEHAT, E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- CS2 CARBON-DISULFIDE ALIQUIPPA PUMP-SUCTION-FILTER-
 990000620 KEHAT, E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- PINE AND MAPLE WOOD, ACTIVATED CARBON APCI-MAR-87
 990000680 FOSTER, R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- EPUN-H-60, POLYCEL-440K, AND STYROFOAM, LUBRICANTS,
 990000690 FOSTER, R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- HOUDRY FOAM INSULATION, AND HAVEN GLASS-FIBER-REIN
 990000660 FOSTER, R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- IGNITION TEST-APPARATUS, FLUORBE-GREASES, EPOXY COM
 990000650 FOSTER, R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- STANDARD IGNITION TEST METHOD, APL PIPING-RESIDUE, APCI
 990000700 FOSTER, R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- TALCUM-POWDER AS A LUBRICANT, TARSLET, PLASTIC APCI
 990000670 FOSTER, R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- POLYESTER RESIN IMPREGNATED FIBERGLASS LAVA APCI
 990000210 APCI PRESSURE-VESSELS-
 990003330 CTIVE-EQUIPMENT ALUMINIZED HEAD-PROTECTIVE CLOTHING, APCI-SAFETY-STD-510.3 13P 8/62
 990000870 APCI BRAZED ALUMINUM HEAT-EXCHANGER CLEANING REQUIREMENTS APCI-QUAL-COINT-LAYOUT-119F 2P 7/1/71
 990003680 APCI BRAZED EXTENDED SURFACE HEAT-EXCHANGERS APCI-ENGR-SPEC-E-02 9P 6/28/70
 990000750 MOLIC RESIN, CUTTING-OILS, HEXADECANE, HYDROCARBON TYPE CUTTING-OILS, KNOWN AS TYPE-GROUP-II, PLANT WASH-OUT S
 990000870 ALLURE OF BRAZED JOINTS IN HIGH-PRESSURE GASEOUS OXYGEN-LINE AT A CYLINDER FILLING DEPT APL-SAFETY-BULL-11
 990001230 COMPATIBILITY TESTS WITH HIGH-PRESSURE OXYGEN APCI-R-D-NOTBOOK-130 P3 1P 6/63
 990001220 COMPATIBILITY TESTS WITH HIGH-PRESSURE OXYGEN APCI-R-D-NOTBOOK-111 P152 1P 1/63
 990002190 LOW-TEMPERATURE-FLUIDS AND HIGH-PRESSURE OXYGEN NATIONAL SAFETY CONGRESS CHICAGO 7P PLUS 9P FIGURES PRE
 990001370 BRUPHY, M. APCI HIGH-PRESSURE OXYGEN COMPATIBILITY TESTS WITH SILICONE-RUBBER GASKET COMPOUND- RTV-
 990001320 WALDE, R.A. APCI KEL-F HIGH-PRESSURE OXYGEN COMPATIBILITY- NYLON APCI-MEMO-63 05/17/73 1P
 990002500 PERATIONS ALLEGEDLY CAUSED HIGHWAY ACCIDENT APCI-SAFETY-GRAM-ND-17 1P 8/10/62
 990004020 CLEANING OF 9% NICKEL AND HI-PROOF STAINLESS STATIC-TANKS FOR OXYGEN SERVICE APL-QCP-Q13 REV.0 1P
 990000970 ATION-PLANT CONTAMINATION- HISTORY, SAMPLING, AND ANALYSIS APCI PLANT MANAGERS SAFETY MEETING-CREIGHTON/
 990003020 REPORT ON SERVICE VISIT TO H.M.S.-EAGLE APL-X0425 5P PLUS APPENDIX A AND B 6/18/71 PLUS MINUTES OF MEETI
 990003020 F MEETING HELD ON BOARD HMS ARK-ROYAL 8/11/71 TO DISCUSS LIQUID-OXYGEN SAFETY REGULATIONS 3P 9/13/71 PL
 990003020 71 PLUS NOTES ON VISIT TO HMS ARK-ROYAL ON 11/8/71 TO DISCUSS SAFETY OF SHIPBOARD LOX-PLANTS 2P 9/13/71
 990004390 RICANTS- FLUOROLUBE, FS-5, HOOKER CHEMICAL APCI-IA1A-11 1P 2/21/72
 990004350 UBRICANTS- FLUOROLUBE, FS, HOOKER CHEMICAL APCI-IA1A-07 1P 2/21/72
 990003780 W. APL CRYOGENIC LIQUID HOSE-CONNECTOR ACCIDENT- GRANITE/CITY APCI-MEMO-67 12/15/67 1P
 990000690 DS, AND EXPLOSION TESTING- HOSE-COUPPLINGS FOR USE IN THE U.K. APL-ENGR-STD-LS.08 6P 10/21/69
 990000130 SCHUYER, W.W. APCI HUMAN TORCHES APCI-SAFETY-GRAM-ND-50C 1P 1/3/66
 990002450 ECTION EQUIPMENT- OUTSIDE HYDRANT-HOUSE AND EQUIPMENT APCI-SAFETY-STD-630.2.3 3P REV-6/15/70
 990001890 -FILM, HYDROCARBON-GREASE, HYDRAULIC-OIL, CHLORINATED-BIPHENYL-AROCIDUR-1254, GRAPHITE-CHLOR-BIPHENYL, VINYL-CH
 990004270 N.I. APL HAZARD LEVEL OF HYDROCARBON FILMS IN OXYGEN SYSTEMS APL-SAFETY-DEPT-INFO-SHEET-41 2P 4/8/71
 990003030 E. APCI HAZARD LEVEL OF HYDROCARBON FILMS IN SYSTEMS CONTAINING LIQUID AND GASEOUS OXYGEN USAF-CONTRAC
 990001990 E. APCI HAZARD LEVEL OF HYDROCARBON FILMS IN SYSTEMS CONTAINING LIQUID AND GASEOUS OXYGEN ADVANCES IN
 990002000 L. APCI HAZARD LEVEL OF HYDROCARBON FILMS IN OXYGEN SYSTEMS AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND A
 990000730 CUTTING-OILS, HEXADECANE, HYDROCARBON TYPE CUTTING-OILS, KNOWN AS TYPE-GROUP-II, PLANT WASH-CUT STUDIES, CELL
 990001890 TEFLON DISPERSION-T-FILM, HYDROCARBON-OIL, TITANIUM-TETRACHLORIDE APCI-MAR-87-0-8822 3P 8/63
 990000740 ANIUM-DIOXIDE, SOLNUS-500, HYDROCARBON-OIL, APCI-MAR-87-0-8822 3P 8/63
 990002060 APCI HYDROSTATIC TESTING-GENERAL APCI-QUAL-COINT-LAYOUT-117A 2P 7/1/71
 990001350 TY TESTS UNDER KU-81-0095 HYDROMAR-UNIVERSAL-JOINTING COMPOUND SQ-32 AND VITON A APCI-IND-ND-81-0095 1P 4/

990004740 S, AND ADHESIVES- NYLON-66 ICI LTD/UK APCI-144-07 1P 2/21/72
 990001030 Y ASPECTS OF RECONSTRUCTED ICI TENNAGE OXYGEN PLANT AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND APPROXIA PLAN
 990002250 T.M.L. APCI REVISIONS TO IGO QUALITY ASSURANCE PROGRAM COST-PROCEEDURES DIST-OPER-MAN-VOL-4-SECT-0.3 APCI
 990001540 K. AERJET-GENERAL CORP IGNITION CHARACTERISTICS OF METALS AND ALLOYS 5K3 JOURNAL P917-23 7P 7/61
 990001530 LLE MEMORIAL INSTITUTE IGNITION OF METALS IN OXYGEN OMC-REPORT-224 33P PLUS APPENDIX
 990005520 INCOMPATIBLE MATERIALS AND IGNITION SOURCES IN DISPOSAL SYSTEMS APCI-IND-2-1 1P 8/22/71
 990001090 I DEVELOPMENT OF STANDARD IGNITION TEST APCI-PROJECT-NO-87-0-8820/1 8P 11/17/61
 990000650 I DEVELOPMENT OF STANDARD IGNITION TEST METHOD, APL PIPING-RESIDUE, METHYLENE-CHLORIDE APCI-MAR-87-0-8821
 990001360 I DEVELOPMENT OF STANDARD IGNITION TEST METHYLENE-CHLORIDE, TRICHLOROETHANE- TRICHOETHYLENE
 990000660 DS, AND EXPLOSION TESTING- IGNITION TEST-APPARATUS, FLUORBE-GREASES, EPOXY COMPOUNDS DEVCON-2-TION AND DEVCON-F
 990001000 KEHAT, E. APCI IGNITION TESTS OF T-FILM AND PENION APCI-MEMO-61 11/28/61 2P
 990001870 BAILEY, B. APCI IGNITION-LIMITS OF CARBON STEEL IN OXYGEN-NITROGEN-ATMOSPHERES APCI-INC-ND-LB-004

990001830 BAILEY, B. APCI IGNITION-LIMITS OF SOME STAINLESS STEELS IN AN OXYGEN-ATMOSPHERE APCI-PROJECT-NO
 990001830 EAT USED IN K-G REGULATOR- APCI IGNITION-TEMPERATURE IN 100-PERCENT OXYGEN ATM APCI-ANAL-REP-60-496 APCI-IWO-N
 990001830 HELL-2-1176-A-HYDROCARBON, APCI INDUOL-CHEMICAL INDUOL-1-10-POLYBUTENE, INDOPOL-H-300-POLYBUTENE, MOBILE-DTE-105-H
 990001830 L INDOPOL-1-10-POLYBUTENE, MOBILE-DTE-105-HYDROCARBON APCI-TM-040 7P 9/18/59
 990001830 DRUGARON, INDOL-CHEMICAL INDOPOL-H-300-POLYBUTENE, INDOPOL-H-300-POLYBUTENE, MOBILE-DTE-105-HYDROCARBON APCI
 990000630 ILS DOW-CURNING-RF-1-0065, INDOPOL-POLYBUTENE-OIL AMOCO-L-10, INDOPOL-POLYBUTENE-OIL AMOCO-H-100, PENTON, T-FI
 990000630 POLYBUTENE-OIL AMOCO-L-10, INDOPOL-POLYBUTENE-OIL AMOCO-H-100, PENTON, T-FI-FILM-THREAD COMPOUND APCI-MAR-87-0-
 990002920 PIPING-SYSTEMS LNG-SYSTEMS DEM-POINT OF AIR-SYSTEMS INERT-CRYOGENS ABOVE THE DEM-POINT OF AIR-SYSTEMS INERT-CRYOGENS ABOVE THE DEM-
 990002920 DEM-POINT OF AIR-SYSTEMS INHIBITOR CRYOGENIC ENGINEERING CONFERENCE PROCEEDINGS 1958 ADVANCES IN CF
 990001890 L, SODIUM-NITRITE-SOLUTION INJURY APCI-SAFETY-GRAM-NO-29 IP 8/17/63
 990003180 BENT-IT ONLY PREVENTS AN INLET CONNECTIONS ASA-657.1 57P 1965
 990002360 CYLINDER VALVE OUTLET AND INLET CONNECTIONS CGA-PAMPHLET-V-1 57P 1965
 990002350 CYLINDER VALVE OUTLET AND INLET CONNECTIONS CSA-B96 57P 1965
 990002370 CYLINDER VALVE OUTLET AND INLET CONNECTIONS CGA-PAMPHLET-V-1 57P 1965
 990001920 APCI MAINTENANCE AND INSPECTION REQUIREMENTS FOR CUSTOMER BULK GAS SUPPLY SYSTEM APCI-DIST-OPER-MAN-V
 990002320 SAFETY-STANDARDS FILING OF INSPECTION AND MAINTENANCE PLANS FEDERAL REGISTER VOL-35 NOV-205 10/31/70
 990002050 CASUALTY CG APCI FIELD INSPECTION CONTRACT WITH MARYLAND CASUALTY CO APCI-POM-SEC-09-ATTCHMT-1 2P
 990000950 APCI CLEANING AND INSPECTION FOR EQUIPMENT IN AIR PLANTS AND IN OXYGEN SERVICE APCI-POM-SEC-1.08 7
 990002120 INSPECTORS NATIONAL BOARD INSPECTION CODE-A MANUAL FOR BOILER AND PRESSURE VESSEL INSPECTORS 150P 1968
 990001930 APCI MAINTENANCE AND INSPECTION OF DECONTAMINATED COMPONENTS, AND PICKLING OF CARBON-STEEL PIPE AND F
 990005810 PROGRAM-SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW PREVENTIVE MAINTENANCE PROGRAM APCI-DIST-OPER-MA
 990005770 PROGRAM-SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW LEAKS APCI-IIIA2-1 IP 9/12/71
 990005780 PROGRAM-SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW GENERAL CONSIDERATIONS OF THE AGING SYSTEM APCI-III
 990005800 PROGRAM-SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW STRUCTURE APCI-IIIA1-1 IP 9/12/71
 990005760 PROGRAM-SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW LEAKS APCI-IIIA2-1 IP 9/12/71
 990000500 APCI CLEANING AND INSPECTION- MATERIALS AND OXYGEN SERVICE APCI-SAFETY-STD-608.1 7P 10/65
 990002210 SSION WITH MR E LUCAS-IPD INSPECTION, REGARDING APCI CLEANLINESS REQUIREMENTS APCI-MEMO-71 07/22/71 2P
 990004110 CHAMBERS, J. APL LOX INSTALLATION AT CUSTOMER SITES APL-160-ENGR-MAN-40-01 7P 7/19/71
 990004170 J. APL PROCEDURE FOR THE INSTALLATION OF A CRYOGENIC TANK APL-160-ENGR-MAN-60-01 6P 5/19/71
 990001900 FIRE PROTECTION ASSOC INSTALLATION OF BULK OXYGEN SYSTEMS AT CONSUMER SITES-1965 NFPA-NO-566 10P 1
 990001910 FIRE PROTECTION ASSOC INSTALLATION OF BULK OXYGEN SYSTEMS AT CONSUMER SITES PROPOSED AMERDMENTS PART
 990002880 APCI OPERATING AND SAFETY INSTRUCTIONS FOR REGULATORS AND COMPRESSED GASES APCI-BROCHURE 4P 4/70
 990002890 APCI SET-UP AND OPERATING INSTRUMENTATION APCI-IIF3-2 2P 2/4/72
 990005680 YEN-TRANSFER-EQUIPMENT OR INSTRUMENTATION PREVENTIVE MAINTENANCE APCI-POM-SEC-6.05 5P 10/30/68
 990002290 APCI INSTRUMENTATION- ESTABLISHING PRESSURE-SETTINGS OF SAFETY DEVICES APCI-DES-ENG-ST
 990002300 APCI INSTRUMENTATION- MODIFICATION TO EXISTING PRESSURE-GAUGES SNUBBER APCI-DES-ENG-ST
 990002820 APCI INSTRUMENTATION- PRESSURE INDICATORS APCI-DES-ENG-STD-531.2 5P 10/63
 990002400 APCI INSTRUMENTATION- SPECIAL REQUIREMENTS SAFETY AND RELIEF VALVES APCI-DES-ENG-STD-5
 990003620 ES FOR FILTERS, TRAPS, AND INSTRUMENTS APCI-IIIB-1 2P 11/1/71
 990001950 COMPRESSED GAS ASSOC INSULATED TANK-TRUCK SPECIFICATION CGA-341 FOR COLO LIQUEFIED-GASES CGA-PAMPHLET
 990001310 OF FIBERIZED MINERAL WOOL INSULATION APCI-QUAL-CONT-LAYOUT-103L 2P 7/1/71
 990000390 APCI INSULATION AND PAINTING- COLD-BOXES THERMAL TANKS PERLITE APCI-DES-ENG-STD-581.1
 990000410 APCI INSULATION AND PAINTING- COLD-BOXES, THERMAL TANKS, GLASS WOOL APCI-DES-ENG-STD-5
 990000400 APCI INSULATION AND PAINTING- COLD-INSULATION AND MINERAL FIBER GRANULATED APCI-DES-EN
 990003750 APCI INSULATION CHECK APCI-IIIA4-1 IP 9/12/71
 990003750 SPECTION WHERE WHY AND HOW FABRICATED FLAT-BOTTOM LQX STORAGE TANKS APCI-IIA4-2 IP 12
 990005430 OVERPRESSURE INTEGRITY OF INSULATION SYSTEM DUE TO VIBRATIONS DETERIORATION APCI-IIF3C-1 IP 12/30/71
 990005740 MALFUNCTIONS AND FAILURES INSULATION MATERIALS FOR CRYOGENIC SYSTEMS MILFOAM URETHANE INSULATION NATIONAL-GY
 990002920 L-x-L. KITSUN,F.K. APCI INSULATION MATERIALS VASCOCEL MILFOAM NATIONAL-GYPSUM (GREEN) FOAM-GLAS (CURNING)
 990002930 PCI FLAMMABILITY TESTS ON INSULATION NATIONAL-GYPSUM-BLUE LOX-SYSTEMS FOAM-GLAS LIQUID-HYDROGEN-PIPING-SYSTSE
 990002920 SYSTEMS MILFOAM URETHANE INSULATION NATIONAL-GYPSUM-BLUE LOX-SYSTEMS FOAM-GLAS LIQUID-HYDROGEN-PIPING-SYSTSE
 990003420 OVERPRESSURE INTEGRITY OF INSULATION SHOP FABRICATED OX STORAGE TANKS APCI-IIA4-1 IP 12/30/71

990003810 PEGRAM, J.M. APL INSULATIONS- PERFORMED CELLULAR GLASS SECTION FOR PIPELINES APL-ENGR-SPEC-N-05 5
 990000660 ON AND DEVCON-F, FOAM-TYPE INSULATIONS STYROFOAM AND POLYURETHANE-FOAM-INSULATION, KAYBESTOS-MANHATTAN-PACKING
 990000690 USION TESTING- HOODRY FUAM INSULATION, AND HAVCO GLASS-FIBER-REINFORCED PLASTIC APCI-NAK-87-0-8821 IP 6/62
 9900005430 UNAL-HAZARDS- OVERPRESSURE INTEGRITY OF INSULATION FIELD FABRICATED FLAT-BOTTOM LOX STORAGE TANKS APCI-I
 9900005420 UNAL-HAZARDS- OVERPRESSURE INTEGRITY OF INSULATION SHOP FABRICATED OX STORAGE TANKS APCI-IIA4-1 IP 12/
 9900004010 RING QUALITY PROCEDURE FOR INTERNAL CLEANING OF ALUMINUM TANKERS AND STATIC-TANKS FOR OXYGEN SERVICE APL-Q
 9900004020 RING QUALITY PROCEDURE FOR INTERNAL CLEANING OF 9% NICKEL AND HI-PROOF STAINLESS STATIC-TANKS FOR OXYGEN SER
 990000880 APCI REQUIREMENTS FOR IPD SPECIFIED PAINT SYSTEMS APCI-QUAL-CUNT-LAYOUT-120F 3P 7/1/71
 9900005200 MENTS- SHPEROIDAL-GRAPHITE IRON CONTINENTAL-STANDARD-GGG-38 APCI-IA6A-34 IP 2/21/72
 9900001890 XANE, LS-53, BUTYL-RUBBER, IRON-OXIDES, TALC, ASBESTOS, ALUMINUM-CHIPS, STEEL-WOOL, MAGNESIUM-CHIPS, MAGNESIUM
 9900003130 ITE THREAD COMPOUND APCI IWO-NO-XD-0134 APCI-ANAL-REP-71-336 IP 10/22/71
 9900002110 SURE VESSEL CODE SECTION IX 88P 1971

 9900003420 KRILL, W.R. APCI JOB SPECIFICATION 310000 GALLON CAPACITY LOX/LIN STORAGE TANK APCI-J08 SPECIF
 9900001460 TS IN OXYGEN ATMOSPHERES JOHN-DURE-CO, MELRATH-GASKET-CO, VALLEY-FORGE-GASKET-CO LOX TRANSFER FLUOROGREEN-E-
 9900004760 CKINGS- FLUCROGREEN-E-600, JOHN/DURE CO APCI-IA5A-04 IP 2/21/71
 9900003890 N TANKER-400-11 1/7/70 AT JOHN/SUMMERS STEEL WORKS/SHOTTON PUMP-TYPE-GB114-SERIAL-NO-79 APL-SAFETY-DEPT-R
 9900004000 AL INSULATIONS- TRANSITE, JOHNS-MANVILLE APCI-IA3A-02 IP 2/21/72
 9900003090 Y OF MATERIAL WITH OXYGEN JOHNS-MANVILLE ASBESTOS SHEET PACKING STYLE-NO-61 GARLOCK-900 APCI-IWO-NO-L8-0
 9900003100 ERIALS GARLOCK-900 DURABLA JOHNS-MANVILLE ASBESTOS SHEET PACKING STYLE-61 APCI-MEMO-71 06/2/71 IP PLUS
 9900003040 TON-A (BLACK) GARLOCK-900 JOHNS-MANVILLE .ASBESTOS-61 SHEET APCI-ANAL-REP-71-344 AND APCI-ANAL-REP-71-3
 9900001890 G COMPANY-GASKET MATERIAL, JOHNS-MANVILLE-76 GASKET MATERIAL, CLOTH-ASBESTOS, GLASS-COTTON-ALUMINIZED-MIL-C-82
 9900003870 I. APL FAILURE OF BRAZED JOINTS IN HIGH-PRESSURE GASEOUS OXYGEN-LINE AT A CYLINDER FILLING DEPOT APL-SAFE

 9900003050 NISSLER, K.H. DEMAG KA-27-IV/KA-4-IV OXYGEN COMPRESSOR VITON-A (BLACK) VITON-E60 (GREEN) DEMAG-LETT
 9900004670 ELASTOMERS, AND ADHESIVES- KEENE-BINDER APCI-IA4A-02 IP 2/21/72
 9900001320 WALDE, R.A. APCI KEL-F HIGH-PRESSURE OXYGEN COMPATIBILITY- NYLON APCI-MEMO-63 05/17/63 IP
 9900004680 ELASTOMERS, AND ADHESIVES- KEL-F-81 APCI-IA4A-03 IP 2/21/72
 9900004330 APCI LUBRICANTS- KEL-F-90 GREASE, MINNESOTA MINING MANUFACTURING CO APCI-IAIA-05 IP 2/21/72
 9900001400 RALUBE-FS, FLUOROLUBE-FS5, KEL-F-LF3, VERSILUBE-F-50, SF81(40)-SILICONE, PYDRAUL-F-9, DOW-CORNING-4 COMPOUND S
 990000720 IY AND EXPLOSION HAZARDS- KEL-F-POLYMER, NYLON, CUTTING-OILS APCI-MAR-87-0-8822 IP 5/63
 9900001890 TYTRICHLOROVINYLCHLORIDE, KEL-F, POLYHEXAFLUOROPROYLENE VITON A VINYLIDEND FLUORIDE, POLYETHYLENE-IRADIATED, POLYVINYLCH
 9900001890 UOHL, METHYL-ETHYL-KETONE, KEROSENE, GLYCERINE, POLYETHYLENE-LOW-DENSITY, POLYETHYLENE-IRADIATED, POLYVINYLCH
 9900000570 IST, J.M. APCI CONTROLLED KINETICS EXPERIMENTATION- TEFLON-HOSE APCI-MAR-87-0-8820 IP 5/60
 9900000580 IST, J.M. APCI CONTROLLED KINETICS EXPERIMENTATION- TEFLON-HOUSE, SUPPORTED BY BRAIDED STAINLESS-STEEL-HOUSING,
 9900004440 I LUBRICANTS- VOLTALCF-3A KINGSLEY AND KEITH LTD/UK APCI-IAIA-16 IP 2/21/72
 9900001330 APCI NYLON-SEAT USED IN K-G REGULATOR- IGNITION-TEMPERATURE IN 100-PERCENT OXYGEN ATM APCI-ANAL-REP-60-4
 9900004857 PCI GASKETS AND PACKINGS- KLINGERIT-601 RICHARD KLINGER LTD/UK
 9900004780 PCI GASKETS AND PACKINGS- KM226-SHEET ASBESTOS GASKET MATERIAL NICOLET INDUSTRIES INC APCI-IA5A-06 IP 2
 9900004810 PCI GASKETS AND PACKINGS- KM246 SHEET-ASBESTOS GASKET MATERIAL NICOLET INDUSTRIES APCI-IA5A-09 IP 2/21/
 9900001420 ER-EXTRACTION GARLOCK-900, KM-226, KM-246 APCI-ANAL-REP-70-013, 70-014, 70-015 APCI-123 APCI-IWO-NO-XD0123
 9900001420 CTION GARLOCK-900, KM-226, KM-246 APCI-ANAL-REP-70-013, 70-014, 70-015 APCI-123 APCI-IWO-NO-XD0123 2P 1/
 9900004290 APCI LUBRICANTS- KRYTOX-143-AA-OIL DUPONT APCI-IAIA-01 IP 2/21/72
 9900004360 APCI LUBRICANTS- KRYTOX-143-AB-OIL DUPONT APCI-IAIA-08 IP 2/21/72
 9900004370 APCI LUBRICANTS- KRYTOX-143-AC-OIL DUPONT APCI-IAIA-09 IP 2/21/72
 9900004430 APCI LUBRICANTS- KRYTOX-143-AA-OIL DUPONT APCI-IAIA-15 IP 2/21/72
 9900004380 APCI LUBRICANTS- KRYTOX-143-AZ-OIL DUPONT APCI-IAIA-10 IP 2/21/72

 9900003430 DESIGN AND CONSTRUCTION OF LARGE, WELDED, LOW-PRESSURE STORAGE TANKS API STANDARD-620 2/70
 9900002460 MASTER, H.H. APCI LAVOP AUTO-LOAD SYSTEM APCI-MEMO-71 03/22/71 2P PLUS 3P ATTACHMENTS
 9900006670 IN IMPREGNATED FIBERGLASS LATHA APCI-MAR-87-0-8821 IP 3/62
 9900001110 POLYVINYLCHLORIDE, PLASTIC LEAD SEAL-NO-2-JOHN CRANE APCI-MEMO-59 01/28/59 2P
 9900005500 TIONAL-HAZARDS- SPILLS AND LEAKAGE APCI-IIO-1 2P 9/5/71
 9900005540 TIONAL-HAZARDS- SPILLS AND LEAKAGE DETECTION- QUANTITY AND RESPONSE TIME LIMITS APCI-IIO4-1 IP 8/22/71
 9900005510 TIONAL-HAZARDS- SPILLS AND LEAKAGE DRAINAGE AND ULTIMATE DISPOSAL ARRANGEMENTS APCI-IIO1-1 2P 8/22/71

990005530 TIONAL-HAZARDS- SPILLS AND LEAKAGE ENVIRONMENTAL WARNINGS AND ESCAPE SYSTEMS APCI-IID3-1 IP 8/22/71

990005520 TIONAL-HAZARDS- SPILLS AND LEAKAGE SEPARATION OF INCOMPATIBLE MATERIALS AND IGNITION SOURCES IN DISPOSAL SYST

990005770 SPECIATION WHERE WHY AND HOW LEAKS APCI-IIIA2-1 IP 9/12/71

990002270 APCI COLD-BOX LEAKS APCI-PUM-SEC-1.14 5P 10/30/68

9900000610 ITION, STANDARD BOMB TEST, LED-PLATE-251, PIPE-DOPE APCI-MAR-87-0-8320 IP 9/61

990001110 EROL-L-536 RUST-PREVENTIVE LEHIGH CHEMICAL CO-CHESTER TOWN-MD., PERMACEL-RIBBON-DOPE PERMACEL-NEW/BRUNSWICK/N

990004280 EVERSUN, I. APL LIMITING VALUES OF OIL-CONTAMINATION OF STAINLESS-STEEL SURFACES EXPOSED TO GASEC

990002470 APCI LOX AND LIN VAPOR DISPOSAL-TANK-500-GAL APCI-DRAWING-924830 REV-8 9/30/68

990005730 (THERMAL AND PRESSURE) LINE-SOURCES APCI-IIIF3B-1 IP 2/18/72

990001950 IFCATION CGA-341 FOR COLD LIQUEFIED-GASES CGA-PAMPHLET-341-TENTATIVE-STANDARDS 13P 1970

990005940 TION REQUIREMENTS FOR BULK APCI LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA- ACCIDENT/INCIDENT INVESTIGATION AND

990000150 S- VAPORIZER AND CRYOGENIC LIQUID CUSTOMER INSTALLATIONS APCI-DIST-OPER-MAN-V-1-SEC-4.2.3 1P 5/69

990004190 APL EXPERIMENTS WITH LIQUID OXYGEN APL SAFETY-BULL-025 1P REPRINTED 1/68

990005990 ON IN THE ATMOSPHERE FROM LIQUID OXYGEN POOLS ADVANCES IN CRYOGENIC ENGINEERING V-13 P555-565 11P 19

990006000 ON IN THE ATMOSPHERE FROM LIQUID OXYGEN POOLS CGA AIR-SEPARATION PLANT SAFETY SYMPOSIUM P12-23 12P

990000170 SCHMOYER, W.W. APCI LIQUID OXYGEN MTP-P+VE-M-63-14 94P 12/4/63

990001280 TIBILITY OF MATERIALS WITH LIQUID OXYGEN NASA-TMX-53052 34P 5/26/64

990001240 TIBILITY OF MATERIALS WITH LIQUID OXYGEN NASA-TMX-985 72P 8/64

990001270 TIBILITY OF MATERIALS WITH LIQUID OXYGEN CONTAMINANTS MISSILE-PROGRAM 10P 1/6/58

990001080 BERGER, F. APCI NOTES ON LIQUID OXYGEN III NASA-TMX-53533 54P 11/3/66

990001250 TIBILITY OF MATERIALS WITH LIQUID OXYGEN IV NASA-TMX-53773 50P 8/23/68

990000030 KITSON, F.K. APCI LIQUID OXYGEN LOADING APCI-SAFETY-GRAM-NO-06 IP 11/17/61

990001890 TIBILITY OF MATERIALS WITH LIQUID OXYGEN METHYL-CHLORIDE, METHYLENE-CHLORIDE, CHLOROFORM, ETHYL-CHLORIDE, UICH

990003000 ON OF ENERGY RELEASE IN A LIQUID OXYGEN PUMP AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-

990002630 RENDOS, J.J. AIRCO LIQUID OXYGEN PUMP FAILURES RE-99000301

990005590 T OVERHAUL PROCEDURES FOR LIQUID PUMPS APCI-IIIF1-4 IP 2/21/72

990003410 FIELD-FABRICATED CRYOGENIC LIQUID STORAGE-TANK (FLAT-BOTTOM) APCI-99820A 18P 9/15/71

990003070 ALUMINUM IN OXYGEN SERVICE LIQUID-CARBONIC-LIQUID-OXYGEN TRAILER- ACCIDENT VICTORY-MEMORIAL-HOSPITAL 5/70 A

990002920 LUE LOX-SYSTEMS FOAM-GLASS LIQUID-HYDROGEN-PIPING-SYSTEMS LNG-SYSTEMS INERT-CRYOGENES BELOW THE DEW-POINT OF

990002690 S ON CENTRIFUGAL PUMPS FOR LIQUID-OXYGEN CRYOGENICS V-10 PP241-248 8P 6/70

990002800 URING CHERISTS ASSOC INC LIQUID-OXYGEN EXPLOSION MCA-CASE-HISTORY-NO-824 2P 8/62

990003070 RDAL FLORIDA 5/11-12/71 LIQUID-OXYGEN PUMPS ALUMINUM IN OXYGEN SERVICE LIQUID-CARBONIC-LIQUID-OXYGEN TRAIL

990003020 -ROYAL 8/11/71 TO DISCUSS LIQUID-OXYGEN SAFETY REGULATIONS 3P 9/13/71 PLUS NOTES ON VISIT TO HMS ARK-ROYA

990002510 Y INFORMATION RELATIVE TO LIQUID-VAPOR-CLOUDS APCI-PAPER 7P 1971

990000930 PENNSALT CORP CLEANING OF LIQUEFIED-GAS PROCESSING EQUIPMENT PENNSALT-TECHNICAL-BULLETIN 6P 2/3/60

990002920 ID-HYDROGEN-PIPING-SYSTEMS MASTER-H.H. APCI AUTG LOAD SYSTEMS APCI-MEMO-71 05/4/71 2P PLUS 3P ATTACHMENTS

990002490 F.K. APCI LIQUID OXYGEN LOADING APCI-SAFETY-GRAM-NO-06 IP 11/17/61

990000030 APCI FLEET SAFETY-PORT, TRANSPORT TO SYSTEM LOADING AND UNLOADING OPERATIONS APCI-SAFETY-STD-635.19 6P 2/68

990001940 ENT- DELUGE-SYSTEM AND LOX LOADING FACILITY APCI-SAFETY-STD-630.2.6 3P 1/64

990000550 PIPING- OXYGEN COMPRESSOR LOCATION APCI-DES-ENG-STD-570.6 2P 1/15/71

990000290 TION OF LARGE, WELDED, LOW-PRESSURE STORAGE TANKS APCI STANDARD-620 2/70

990003460 APCI SAFETY RELIEF VALVES LOW-TEMPERATURE-FLUIDS AND HIGH-PRESSURE OXYGEN NATIONAL SAFETY CONGRESS CHICA

990002190 GER, F. APCI HANDLING OF LOX AND LIN VAPOR DISPOSAL-TANK-500-GAL APCI-DRAWING-924830 REV-8 9/30/68

990004110 CHAMBERS, J. APL LOX INSTALLATION AT CUSTOMER SITES APL-IGD-ENGR-MAN-40-01 7P 7/19/71

990003100 ROBINSON, G.W. APCI COMPATIBLE GASKET MATERIALS GARLUCK-900 DURABLA JOHNS-BANVILLE ASBESTOS SHEET

990005430 D FABRICATED FLAT-BOTTOM LOX STORAGE TANKS APCI-IIA4-2 IP 12/30/71

990000520 UIPMENT- DELUGE-SYSTEM AND LOX LOADING FACILITY APCI-SAFETY-STD-630.2.6 3P 1/64

990000900 ATLEY, A.L. APCI CLEANING LOX STORAGE TANK-NO-6 SANTA/SUSANA APCI-MEMO-64 03/11/64 IP PLUS IP ATTACHMENT

990003140 PTURE DISCS MANUFACTURED LOX TANKERS BY AMETEK APCI-MEMO-71 06/22/71 1P
 990000910 MASTER, H.H. APCI LOX TANKS APCI-MEMO-70 06/26/70 1P
 990001460 CG, VALLEY-FORGE-GASKET-CG LOX TRANSFER FLUOROGREEN-E-600 APCI-MEMO-70 10/23/70 1P
 990002660 MASTER, H.H. APCI LOX TRANSFER PUMP SCREENS APCI-MEMO-69 01/24/69 2P PLUS 3P ATTACHMENTS
 990002650 MASTER, H.H. APCI LOX TRANSFER PUMPS APCI-MEMO-68 12/30/68 2P PLUS 2P ATTACHMENTS
 990003020 DISCUSS SAFETY OF SHIPBOARD LOX-PLANTS 2P 9/13/71
 990003930 INVESTIGATION OF CRYOSTAR LOX-PUMP EXPLOSION AT STOKES PLANT 8/7/70 APL-SAFETY-DEPT-REP-34 14P 8/24/70
 990002580 BERRETTINI, B.J. APCI LOX-PUMP FIRES AND EXPLOSIONS APCI-MEMO-70 06/26/70 3P
 990003920 DUE TO THE CRYOSTAR-GB114 LOX-PUMP ON AN SSPC LOX-TANKER APL-SAFETY-DEPT-REP-32 9P 7/10/70
 990003890 PL REPORT ON EXPLOSION OF LOX-PUMP ON TANKER-400-11 1/7/70 AT JGHN/SUMMERS STEEL WORKS/SHOTGUN PUMP-TYPE-C
 990002680 STOMPLER, R.D. APCI LOX-PUMP SAFETY APCI-MEMO-71 2/19/71 1P
 990002670 AUL, CARTER, AND COSMODYNE LOX-PUMP SAFETY APCI-MEMO-71 1/01/26/71 2P
 990003270 STOMPLER, R.D. APCI LOX-PUMP SAFETY-BARRIERS APCI-MEMO-71 02/19/71 2P
 990003880 IN BURCKHARDT CENTRIFUGAL LOX-PUMP-TYPE-GB114-NO-29224 APL-SAFETY-DEPT-REP-16 6P 2/28/69
 990002200 BALL, W.L. APCI LOX-SPILL NCG CONSHUHOCKEN APCI-MEMO-68 05/23/68 2P
 990002920 ATION NATIONAL-GYPSUM-BLUE LUX-SYSTEMS FOAM-GLASS LIQUID-HYDROGEN-PIPING-SYSTEMS LNG-SYSTEMS INERT-CRYOGENES B
 990000920 LYSIS OF SUN-OIL COMPANY_S LOX-TANK VAPORIZER APCI-MEMO-64 04/9/64 1P PLUS 1P ATTACHMENT
 990003420 N 310000 GALLON CAPACITY LOX/LIN STORAGE TANK APCI-JOB SPECIFICATION FOR JOB-NO-00-2-2775 APCI-NO-71-
 990001690 ANE, FLUORINATED-SILOXANE, LS-53, BUTYL-RUBBER, IRON-OXIDES, TALC, 4SBESTOS, ALUMINUM-CHIPS, STEEL-WOOL, MAGNE
 990001820 APCI PIPING-SSL1.5- LUBE-OIL-SERVICE -20F TO 150F 150-PSIG-MAX STAINLESS STEEL-PIPE APCI-DES-ENG-S
 990001110 DUS MATERIALS- ABMA THREAD LUBRICANT AND SEALER, ANDEROL-L-536 RUST-PREVENTIVE LEHIGH CHEMICAL CO-CHESTERTON
 990001160 APCI TAPE-SEAL THREAD LUBRICANT AND SEALER- TAPE-SEAL FROM FRIESLAND-PLASTIC COMPANY, PERMACEL-TAPE AP
 990000090 SCHMOYER, W.W. APCI LUBRICANTS AND THREAD COMPOUNDS FOR OXYGEN-SYSTEMS APCI-SAFETY-GRAM-NO-27 5P 3/
 990004450 APCI LUBRICANTS- ESSO BEACON-325 APCI-IA1A-17 1P 2/21/72
 990004420 APCI LUBRICANTS- FLUORO-GLIDE, CHEMPLAST INC APCI-IA1A-14 1P 2/21/72
 990004390 APCI LUBRICANTS- FLUOROLUBE, FS-5, HOOKER CHEMICAL APCI-IA1A-11 1P 2/21/72
 990004460 APCI LUBRICANTS- FLUOROLUBE, FS, HOOKER CHEMICAL APCI-IA1A-07 1P 2/21/72
 990004300 APCI LUBRICANTS- FORMBLIN-Y04 MONTECATINI-EDISON APCI-IA1A-18 1P 2/21/72
 990004310 APCI LUBRICANTS- HALOCARBON-11-21E, HALOCARBON PRODUCTS CORP APCI-IA1A-02 1P 2/21/72
 990004340 APCI LUBRICANTS- HALOCARBON-11-14E, HALOCARBON PRODUCTS CORP APCI-IA1A-03 1P 2/21/72
 990004320 APCI LUBRICANTS- HALOCARBON-25-5S-GREASE, HALOCARBON PRODUCTS CORP APCI-IA1A-06 1P 2/
 990004330 APCI LUBRICANTS- HALOCARBON-6-25-WAX, HALOCARBON PRODUCTS CORP APCI-IA1A-04 1P 2/21/
 990004290 APCI LUBRICANTS- KEL-F-90-GREASE, MINNESOTA MINING MANUFACTURING CO APCI-IA1A-05
 990004360 APCI LUBRICANTS- KRYTOX-143-AA-OIL DUPONT APCI-IA1A-01 1P 2/21/72
 990004370 APCI LUBRICANTS- KRYTOX-143-AB-OIL DUPONT APCI-IA1A-08 1P 2/21/72
 990004430 APCI LUBRICANTS- KRYTOX-143-AC-OIL DUPONT APCI-IA1A-09 1P 2/21/72
 990004380 APCI LUBRICANTS- KRYTOX-143-AD-OIL DUPONT APCI-IA1A-15 1P 2/21/72
 990004410 APCI LUBRICANTS- KRYTOX-143-AZ-OIL DUPONT APCI-IA1A-10 1P 2/21/72
 990004400 APCI LUBRICANTS- MOLYLUBE-NO-99, MOLYLUBE PRODUCTS GLEN/COVE/NY APCI-IA1A-13 1P
 990004440 APCI LUBRICANTS- MOLYLUBE-N BEL-RAY CO FARMINGDALE/NJ APCI-IA1A-12 1P 2/21/72
 990000680 LYCEL-440R, AND STYROFOAM, LUBRICANTS, MGLEY-SPRAY-KOTE, AND DRI-LUBE APCI-MAR-87-0-8821 1P 4/62
 990000900 PLUSIGN TESTING- UCON-TYPE LUBRICANTS, STEEL-PIPES APCI-MAR-87-0-8820 1P 4/61
 990000700 ESTING- TALCUM-POWDER AS A LUBRICANT, TARSET, PLASITE APCI-MAR-87-0-8821 1P 7/62
 990002210 PCI DISCUSSION WITH MK E LUCAS-IPD INSPECTION, REGARDING APCI CLEANLINESS REQUIREMENTS APCI-MEMO-71 07/22

 990000270 APCI MACHINERY- FIELD TESTING AND CENTRIFUGAL OXYGEN COMPRESSORS APCI-DES-ENG-STD-551.
 990000260 APCI MACHINERY- FIELD TESTING AND RECIPROCATING OXYGEN COMPRESSORS APCI-DES-ENG-STD-55
 990001890 LUMINUM-CHIPS, STEEL-WOOL, MAGNESIUM-CHIPS, MAGNESIUM-SHEET, DYE-PENETRANTS, MAGNOGLO-PASTEIO IN KEROSENE, TU
 990001890 EEL-WOOL, MAGNESIUM-CHIPS, MAGNESIUM-SHEET, DYE-PENETRANTS, MAGNOGLO-PASTEIO IN KEROSENE, TU
 990001890 IUM-SHEET, DYE-PENETRANTS, MAGNOGLO-PASTEIO IN KEROSENE, TURCO-DYE-CHECK-STE
 990005670 L-HAZARDS- OXYGEN-TRANSFER MALFUNCTION AND FAILURES APCI-11F3-1 1P 11/12/71
 990005680 L-HAZARDS- OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES APCI INCIDENTS INVOLVING OXYGEN-TRANSFER-EQUIPMENT OR INST
 990005690 L-HAZARDS- OXYGEN-TRANSFER MALFUNCTIONS AND FAILURE INCIDENTS WHICH OCCURRED WITH OTHER OXYGEN-EQUIPMENT APCI
 990005730 L-HAZARDS- OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES GETSEIING, EXCESSIVE VIBRATIONS, SHOCK (THERMAL AND PRE

990005740 L-HAZARDS- OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES INSULATION SYSTEM DUE TO VIBRATIONS DETERIORATION APC
 990005720 L-HAZARDS- OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES VALVES APCI-IIF3A(3)-1 1P 12/30/71
 990003830 ENT AT AN OXYGEN CHARGING MANIFOLD APL-SAFETY-BULL-046 2P
 990003840 RISING FROM VENTING-OXYGEN MANIFOLDS CONNECTED TO A COMMON VENT PIPE APL-SAFETY-BULL-075 3P 12/11/69
 990003760 CHARGING AND DISCHARGING MANIFOLDS OXYGEN SERVICE APL-ENGR-SPEC-L.12.1 2P 7/7/69
 990000620 XPLOSION TESTING- PINE AND MAPLE WOOD, ACTIVATED CARBON APCI-MAR-87-G-8821 1P 10/61
 990002050 D INSPECTION CONTRACT WITH MARYLAND CASUALTY CO APCI-POM-SEC-6.09-ATTCHMT-1 2P 8/27/69
 990001890 0070, WALK-SYNTHETIC-CORK, MASKING-TAPE, SHERLOCK-LEAK-DETECTOR-TYPE-0G, SHERLOCK-LEAK DETECTOR-WITH-15-PERCEN
 990003080 SCHNYDER, R. APCI MASTER DRAWING 1200-SERIES REGULATIONS APCI-DRAWING-000-0-407004E 1P 3/4/68
 990003570 NFIRMATION OR REVISION OF MAXIMUM ALLOWABLE OPERATING PRESSURE FEDERAL REGISTER VOL-36 NO-176 9/10/71
 990002220 ERSATION WITH MR WILLIAM MCCORMICK REGARDING REQUIREMENTS FOR VENDOR-CLASS-AA AND CLASS-AAA CLEANING APCI
 990001890 ADHESIVE, PHENOLIC-MOLDED, MELAMINE-MOLDED, POLYESTER-GLASS, NYLON, MOLYBDENUM-DISULFIDE, GRAPHITE, ELECTRIFIL
 990001410 D SOXHLET ETHER-EXTRACTION MELRATH GARLOCK-900 APCI-ANAL-REP-70-026 APCI-1W0-NO-EA-7027 2P 1/30/70
 990004740 ND PACKINGS- TFE-GF-GREEN, MELRATH GASKETS CO APCI-IA5A-02 1P 2/21/72
 990001410 MATERIAL COMPATIBILITY OF MELRATH MATERIAL WITH OXYGEN COMBUSTION IN OXYGEN AND SOXHLET ETHER-EXTRACTION MEL
 990004770 PCI GASKETS AND PACKINGS- MELRATH-150 (SHEET-ASBESTOS GASKET MATERIAL) APCI-IA5A-05 1P 2/21/72
 990001460 ATMOSPHERES JOHN-DORE-CO, MELRATH-GASKET-CO, VALLEY-FORGE-GASKET-CO LOX TRANSFER FLUOROGREEN-E-600 APCI-MEM
 990005980 N PRESSURE VESSEL CODE-AD MERKBLATTER (ENGLISH TRANSLATION) 304P 9/71
 990001540 GNITION CHARACTERISTICS OF METALS AND ALLOYS ARS JOURNAL P917-23 7P 7/61
 990001530 AL INSTITUTE IGNITION OF METALS IN OXYGEN DMIC-REPORT-224 33P PLUS APPENDIX
 990005950 DALY, J. APCI BURNING OF METALS IN OXYGEN ATMOSPHERES (80 TO 100-PERCENT) APCI-TM-186 44P 3/72
 990001520 INSTITUTE REACTIVITY OF METALS WITH LIQUID AND GASEOUS OXYGEN AD297124 DMIC-MEMO-163
 990005230 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- MUNTZ-METAL 60-40-TYPE COMPOSITI
 990005240 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALPHA BRASS-TYPE TCL-100 OR DTD-50
 990004920 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- RED-BRASS-PIPE ASTM-843 APCI-IA6
 990004900 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- COPPER-PIPE ASTM-B42 APCI-IA6A-0
 990004930 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B211-2024-T4 APCI-
 990004870 APCI METALS, ALLOYS, SGLDERS, AND SURFACE TREATMENTS- TAFSET PITTSBURGH CHEMICAL CO
 990004880 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- SEALFAS-MASTIC-31-97 BENJAMIN FOS
 990004910 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- COPPER-TUBE ASTM-B75 APCI-IA6A-0
 990004890 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- PLASITE-NO-7122H WISCONSIN PROTEC
 990004950 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B209-5083-0 APCI-I
 990005190 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- CARBON STEEL- NON-OXYGEN SERVICE W
 990005080 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL-TYPE-304 UNIDENTIF
 990005110 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- BERYLLIUM COPPER APCI-IA6A-25 2
 990005070 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A182-F-304 AN
 990004990 APCI METALS, ALLOYS, SGLDERS, AND SURFACE TREATMENTS- ALUMINUM B361-WP6061-T6 APCI-IA6
 990005020 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A240-304 AP
 990005090 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- COPPER-SILICON ASTM-B986RB APCI-
 990005120 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A269-304 AP
 990004980 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B247-6061-T6 APCI-
 990005200 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- SHPEROIDAL-GRAPHITE IRON CONTINENT
 990005050 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A194-BT321
 990005050 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A403-WP304 AN
 990005000 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- CARBON STEEL (OXYGEN SERVICE) A
 990005100 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- FREE-MACHING BRASS APCI-IA6A-24
 990005150 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- MONEL ASTM-B164 APCI-IA6A-29 2P
 990005010 APCI METALS, ALLOYS, SGLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A312-TP304
 990005130 APCI METALS, ALLOYS, SGLDERS, AND SURFACE TREATMENTS- BRONZE ASTM-B51 OR B62 APCI-IA6
 990005210 APCI METALS, ALLOYS, SGLDERS, AND SURFACE TREATMENTS- SILVER APCI-IA6A-35 1P 2/21/72
 990004960 APCI METALS, ALLOYS, SGLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B210-6061-T6 APCI-
 990005060 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEELS-TYPE-416-CADMIUM-
 990005040 APCI METALS, ALLOYS, SGLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A320-88304
 990004970 APCI METALS, ALLOYS, SGLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B241-6061-T6 APCI-

990005100 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A351-GR-CF8
 990005170 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS 9-PERCENT NICKEL STEEL
 990005220 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- NOVUMOX STAINLESS STEEL ALLOY TU
 990005140 APCI METALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- BRASS-SHEET OR PLATE ASTM-B36 A
 990005300 CALS, SOLVENTS, AND MISC- METHYLENE-CHLORIDE APCI-IA7A-06 IP 2/21/72
 990000650 ETHOD, APL PIPING-RESIDUE, APCI-MAR-87-0-8821 IP 1/62
 990001070 TION FILTER DEFROST AND OF METHYLENE-CHLORIDE APCI-MEMO-61 12/11/61 2P
 990001360 OF STANDARD IGNITION TEST METHYLENE-CHLORIDE- DICHLOROETHANE- TRICHLOROETHANE- CARBON-TETRA
 990001650 IC OXYGEN METHYL-CHLORIDE, METHYLENE-CHLORIDE, CHLOROFORM, ETHYL-CHLORIDE, DICHLOROETHANE, TRI
 990001890 TERIALS WITH LIQUID OXYGEN METHYL-CHLORIDE, METHYLENE-CHLORIDE, CHLOROFORM, ETHYL-CHLORIDE, DICHLOROETHANE, DI
 990001890 ROETHYLENE, ETHYL-ALCOHOL, METHYL-ETHYL-KETONE, KEROSENE, GLYCERINE, POLYETHYLENE-LOW-DENSITY, POLYETHYLENE-IR
 990004940 APCI METLAS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM, ASTM-B-210-3003 APCI-I
 990005180 APCI METLAS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- COPPER-TUBE ASTM-B88 APCI-IA6A-
 990004640 LOCAL INSULATIONS- MILFOAM MILFOAM CORP APCI-IA3A-06 IP 2/21/72
 990004640 D ELECTRICAL INSULATIONS- MILFOAM NATIONAL GYPSUM (GREEN) FOAM-GLAS (CURNING) APCI-IWO-NO-LA-0333 APCI-
 990002950 ULATION MATERIALS VASCOCEL MILFOAM URETHANE INSULATION NATIONAL-GYPSUM-8LUE LOX-SYSTEMS FOAM-GLASS LIQUID-HYDR
 990002920 ALS FOR CRYOGENIC SYSTEMS MILFOAM URETHANE INSULATION NATIONAL-GYPSUM-8LUE LOX-SYSTEMS FOAM-GLASS LIQUID-HYDR
 990000400 NTING- COLO-INSULATION AND MINERAL WOOL GRANULATED APCI-DES-ENG-STU-58L-2 2P 6/26/69
 990003600 PEGRAM,J.W. APL MINERAL WOOL APL-ENGR-SPEC-N-02 3P 1/2/70
 990001310 H ACCEPTANCE OF FIBERIZED MINERAL WOOL INSULATION APCI-QUAL-CONT-LAYJUT-103L 2P 7/1/71
 990004620 D ELECTRICAL INSULATIONS- MINERAL-WOOL APCI-IA3A-04 IP 2/21/72
 990003530 NO OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS UDRIZATION OF GAS FEDERAL REGISTER VOL-35 N
 990003570 NO OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS EXTENSION OF TIME FOR CONFIRMATION OR REVISION O
 990003520 FICE OF PIPELINE SAFETY FEDERAL SAFETY-STANDARDS FOR GAS PIPELINS CORUSION-PITTING- NOTICE OF PUB
 990003550 NO OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS FILING JF INSPECTION AND MAINTENANCE PLANS FEDE
 990003560 NO OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS REQUIREMENTS FOR CORROSION CONTROL FEDERAL REG
 990003540 NO OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS MISC AMENDMENTS FEDERAL REGISTER V-35 N-223
 990003510 NO OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS ESTABLISHMENT OF MINIMUM STANDARDS FEDERAL RE
 990004330 BRICANTS- KEL-F-90-GREASE, MINNESOTA MINING MANUFACTURING CO APCI-IAIA-05 IP 2/21/72
 990001080 LIQUID OXYGEN CONTAMINANTS MISSILE-PROGRAM 10P 1/6/58
 990002500 YER,J.W. BALL,J.L. APCI MISTY PROBLEM VAPOR-CLOUDS FROM DEFROST OPERATIONS ALLEGEDLY CAUSED HIGHWAY ACCIDE
 990001400 INDOPUL-H-300-POLYBUTENE, MOBILE-DTE-105-HYDROCARBON APCI-TM-040 7P 9/18/59
 990003110 OF VARIOUS TYPES OF OILS- MOBIL-DTE-105 TEXACO-CAPPELLA-AA CELLULUBE-550 FLUORLUBE SEARS-THREAD-CUTTING-GIL
 990001230 BRICANTS- MOLY-LUBE-NO-99, APCI GROPHY,M. APCI MOLY-LUBE PRODUCTS GLEN/COVE/NY APCI-IAIA-13 IP 2/21/72
 990001890 D, POLYESTER-GLASS, NYLON, MOLY-LUBE-NO-99 APCI-MEMO-63 06/11/63 IP
 990001170 YGEN COMPATIBILITY TEST UN MOLY-LUBE-NO-99, MOLY LUBE PRODUCTS GLEN/COVE/NY APCI-IAIA-13 IP 2/21/72
 990004410 APCI LUBRICANTS- MOLY-LUBE-NO-99, MOLY LUBE PRODUCTS GLEN/COVE/NY APCI-IAIA-13 IP 2/21/72
 990000680 AND STYROFOAM, LUBRICANTS, MOLY-SPRAY-KOTE, AND DRI-LUBE APCI-MAR-87-0-8821 IP 4/62
 990000710 UGE TWF WOOL, SPINTEX-305, MOLYKOTE-TYPE-Z AND TYPE-X-15 APCI-MAR-87-0-8822 IP 3/63
 990000730 - HALOCARBON, MOLY-LUBE-99, MOLYKOTE-TYPES-Z AND X-15, CABOSIL-M-5 FORMICA-LAMINATE BUNDED WITH A PHENOLIC RE
 990000730 OSION HAZARDS- HALOCARBON, MOLY-LUBE-99, MOLYKOTE-TYPES-Z AND X-15, CABOSIL-M-5 FORMICA-LAMINATE BUNDED WITH
 990001200 YGEN COMPATIBILITY TESTS- MOLY-LUBE-KOTE-AR AND MOLY-LUBE-N APCI-R+D-NOTEBOOK-130 P16-7 2P 2/11/63
 990001150 REGULATOR THREAD SEALANT MOLY-LUBE-N APCI-MEMO-63 10/4/63 IP
 990001200 ESTS- MOLY-LUBE-KOTE-AR AND MOLY-LUBE-N APCI-R+D-NOTEBOOK-130 P16-7 2P 2/11/63
 990004510 S AND THREADING COMPOUNDS- MOLY-LUBE-N BEL-RAY CO FARMINGDALE/NJ APCI-IA2A-05 IP 2/21/72
 990004400 APCI LUBRICANTS- MOLY-LUBE-N BEL-RAY CO FARMINGDALE/NJ APCI-IA1A-12 IP 2/21/72
 990005150 S, AND SURFACE TREATMENTS- MOLY-LUBE-N BEL-RAY CO FARMINGDALE/NJ APCI-IA6A-29 2P 2/21/72
 990001400 A-CORP-MOLYKOTE-MICROSIZE, MONSANTO-PYDRAUL, GULF-MECHANISM-HYDROCARBON, HAVOLINE-HO-HYDROCARBON, SHELL-2-1176
 990004460 LUBRICANTS- FORMBLIN-Y04 MONTECATINI-EDISON APCI-IAIA-18 IP 2/21/72
 990001400 FAIRBANKS-SILICONE-DC-44, MORSE GREASE, ALPHA-CORP-MOLYKOTE-MICROSIZE, MONSANTO-PYDRAUL, GULF-MECHANISM-HYDRO
 99000230 S, AND SURFACE TREATMENTS- MURTZ-METAL 60-40-TYPE COMPOSITION CU-58 1-PERCENT ZN38.5-42-PERCENT P80.35-9-
 990001690 OLYETHYLENE-TEREPHTHALATE, MYLAR, POLYTETRAFLUOROETHYLENE, TEFLON, POLYTRICHLOROFLUOROVINYLCHLORIDE, KEL-F, POLYHEX

990005400 SCHMUYER,W.W. APCI NASA OXYGEN STUDY PROJECT 00-I-2495.07 APCI-MEMO-71 12/10/71 IP

990002760 KITSOR, F.K. APCI NASH VACUUM PUMPS APCI-MEMO-71 01/19/71 2P
 990002120 VESSEL INSPECTORS NATIONAL BOARD INSPECTION CODE-A MANUAL FOR BOILER AND PRESSURE VESSEL INSPEC
 990004500 GING COMPOUNDS- PUTTI-ROPE NATIONAL GREENHOUSE CO APCI-IA2A-04 IP 2/21/72
 990004650 IONS- NATIONAL-GYPSUM-BLUE NATIONAL-GYPSUM CORP APCI-IA3A-07 IP 2/21/72
 990002930 MATERIALS VASCOCCEL MILFOAM NATIONAL-GYPSUM (CKEEN) FOAM-GLAS (CORNING) APCI-IWO-NO-LA-0333 APCI-MEMO-68
 990002920 ILFOAM URETHANE INSULATION NATIONAL-GYPSUM-BLUE LOX-SYSTEMS FOAM-GLASS LIQUID-HYDROGEN-PIPING-SYSTEMS LNG-SYST
 990004650 D ELECTRICAL INSULATIONS- NATIONAL-GYPSUM-BLUE NATIONAL-GYPSUM CORP APCI-IA3A-07 IP 2/21/72
 990004840 ESTOS AND CEMENT BOAKUS. NATURAL-UNTREATED-FINISH TURNERS ASBESTOS CEMENT CO LTD/UK APCI-IA5A-12 IP
 990002200 BALL, W.L. APCI LGX-SPILL NCG CONSHUCKEN APCI-MEMO-68 05/23/68 2P
 990002790 MASTER, H.H. APCI NEAR-MISS ACCIDENT- BURNS/HARBOR APCI-MEMO-71 02/8/71 2P
 990002810 HUBBS, M.H. APCI NEAR-MISS ACCIDENT- GREIGHTON APCI-MEMO-68 06/4/68 2P
 990002780 HUBBS, M.K. APCI NEAR-MISS ACCIDENT- GRANITE/CITY FACILITY APCI-MEMO-67 12/15/67 IP
 990004700 ELASTOMERS, AND ADHESIVES- NEOPRENE APCI-IA4A-05 IP 2/21/72
 990001890 GLYSULFIDE-SEALER, BUNA-N, NEOPRENE, EPOXY-ADHESIVE, PHENOLIC-MOLDED, MELAMINE-MOLDED, POLYESTER-GLASS, NYLON,
 990004020 R INTERNAL CLEANING OF 9% NICKEL AND HI-PROOF STAINLESS STATIC-TANKS FOR OXYGEN SERVICE APL-QCP-Q13 REV.0
 990005170 ENTS- STAINLESS 9-PERCENT NICKEL STEEL ASTM-A3536B APCI-IA6A-31 2P 2/21/72
 990004810 -ASBESTOS GASKET MATERIAL NICOLET INDUSTRIES APCI-IA5A-09 IP 2/21/72
 990004780 ASBESTOS GASKET MATERIAL NICOLET INDUSTRIES INC APCI-IA5A-08 IP 2/21/72
 990003250 TRIAL-SAFETY- OCCUPATIONAL NOISE APCI-SAFETY-STD-625.0.1.2 3P 4/9/71
 990003230 VE-EQUIPMENT- OCCUPATIONAL NOISE PROTECTIV
 990005190 TREATMENTS- CARBON STEEL NON-OXYGEN SERVICE WITH POSSIBLE EXPOSURE TO OXYGEN APCI-IA6A-33 3P 2/21/72
 990001290 NASA-HOUSTON NGNMETALLIC MATERIALS DESIGN GUIDELINES AND TEST DATA-HANDBOOK MSC-02681 380P 5
 990005380 AL-MATERIALS-COMPATIBILITY EVERSON, I. APL NOTES FOR GUIDANCE OF CUSTOMERS HAVING AIR PRODUCTS LTD OXYGEN EQUIPMENT AP
 990004220 ULATIONS 3P 9/13/71 PLUS NOTES ON VISIT TO HMS ARK-ROYAL ON 11/8/71 TO DISCUSS SAFETY OF SHIPBOARD LOX-PL
 990001080 HIMMELBERGEN, F. APCI NOTES ON LIQUID OXYGEN CONTAMINANTS MISSILE-PROGRAM 10P 1/6/58
 990003550 PELINES CORROSION-PITTING- NOTICE OF PUBLIC HEARING FEDERAL REGISTER VOL-36 NO-126 6/30/71
 990005220 S, AND SURFACE TREATMENTS- NOVONOX STAINLESS STEEL ALLOY TO DIN GERMAN NATIONAL STANDARDS COMPOSITION 5-P
 990004690 ELASTOMERS, AND ADHESIVES- NYLON APCI-IA4A-04 IP 2/21/72
 990001320 SURE OXYGEN COMPATIBILITY- NYLON APCI-MEMO-63 05/17/63 IP
 990004720 ELASTOMERS, AND ADHESIVES- NYLON-66 ICI LTD/UK APCI-IA4A-07 IP 2/21/72
 990001330 YODER, L. APCI NYLON-SEAT USED IN K-G REGULATOR- IGNITION-TEMPERATURE IN 100-PERCENT OXYGEN ATM
 990000720 UN HAZARDS- KEL-F-POLYMER, NYLON, CUTTING-OILS APCI-MAR-87-05-8822 IP 5/63
 990001890 E-MOLDED, POLYESTER-GLASS, NYLON, MOLYBDENUM-DISULFIDE, GRAPHITE, ELECTROFILM-SPRAYABLE-4, DRILUBE-1, TEFLON D
 990003250 APCI INDUSTRIAL-SAFETY- OCCUPATIONAL NOISE APCI-SAFETY-STD-625.0.1.2 3P 4/9/71
 990003230 NREL-PROTECTIVE-EQUIPMENT- OCCUPATIONAL NOISE PROTECTIV
 990003880 WHEN AN EXPLOSION AND FIRE OCCURRED IN BURKHARDT CENTRIFUGAL LUX-PUMP-TYPE-GB114-NU-29224 APL-SAFETY-DEPT-R
 990005690 ND FAILURE INCIDENTS WHICH OCCURRED WITH OTHER OXYGEN-EQUIPMENT APCI-IIF3-6 2P 2/3/72
 990003530 M FEDERAL SAFETY-STANDARDS ODOORIZATION OF GAS FEDERAL REGISTER VOL-35 NO-220 11/11/70
 990001120 PUTTI-ROPE ANALYSIS FOR OIL CONTENT AND FLAMMABILITY TEMPERATURE APCI-MEMO-59 12/11/59 IP
 990001070 APCI DETONATION TESTS OF OIL FROM ALIQUIPPA PUMP-SUCTION FILTER DEFROST AND OF METHYLENE-CHLORIDE APCI-MEM
 990004230 ALTITATIVE AND QUANTITATIVE OIL ANALYSIS APCI-ANAL-REP-63-1662 AND 1663 APCI-IWO-NO-69-1034 IP 11/6/63
 990004280 APL LIMITING VALUES OF OIL-CONTAMINATION OF STAINLESS-STEEL SURFACES EXPOSED TO GASEOUS OXYGEN APL-SA
 990002010 MICAL STRUCTURE OF CUTTING OILS TO THEIR OXYGEN-COMPATIBILITY AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMM
 990005110 SCENCE OF VARIOUS TYPES OF OILS- MOBIL-DTE-105 TEXACO-CAPPELLA-AA CELLULORE-550 FLUOROLUBE SEARS-THREAD-CUTTIN
 990002350 RESSSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS CGA-B96 57P 1965
 990002370 RESSSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS CGA-B96 57P 1965
 990002360 RESSSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS CGA-B96 57P 1965
 990004180 DAVIES, G. APL OVERHAUL PROCEDURE APL-C-155/9.5 33P 1971
 990005410 APCI OPERATIONAL-HAZARDS- OVERPRESSURE APCI-11A-1 2P 2/18/72
 990005420 APCI OPERATIONAL-HAZARDS- OVERPRESSURE INTEGRITY OF INSULATION SHIP FABRICATED OX STORAGE TANKS APCI-II
 990005430 APCI OPERATIONAL-HAZARDS- OVERPRESSURE INTEGRITY OF INSULATION FIELD FAB-ICATED FLAT-BOTTOM LDX STORAGE T
 990004560 S AND THREADING COMPOUNDS- OXGMAT APCI-IA2A-10 IP 2/21/72
 9900001210 APCI SAFETY-VALVE-SEAT OXGMAT FLAMMABILITY IN 100-PERCENT GASEOUS OXYGEN APCI-ANAL-REP-61-435 APCI-I

990001520 WITH LIQUID AND GASEOUS OXYGEN AU297124 DMIC-MEMO-163
 990005960 F MATERIALS WITH 7500-PSI OXYGEN AD608266 7IP 10/64
 990001210 Y IN 100-PERCENT GASEOUS OXYGEN APCI-ANAL-REP-61-435 APCI-IWO-NO-10-0858 IP 6/6/61
 990001220 Y TESTS WITH HIGH-PRESSURE OXYGEN APCI-R+D-NCTEBOOK-111 P152 LP 1/63
 990001230 Y TESTS WITH HIGH-PRESSURE OXYGEN APCI-R+D-NCTEBOOK-130 P3 IP 6/63
 990000170 CHMOYER, W.W. APCI LIQUID OXYGEN APCI-SAFETY-GRAM-NO-54C 6P 1/31/67 P6 REVISED 1/31/68
 990000070 HMOYER, W.W. APCI GASEOUS OXYGEN APCI-SAFETY-GRAM-NU-23C 6P 1/10/63
 990001530 UTE IGNITION OF METALS IN OXYGEN DMIC-REPORT-224 33P PLUS APPENDIX
 990001280 Y OF MATERIALS WITH LIQUID OXYGEN MIP-P+VE-N-63-14 94P 12/4/63
 990001240 Y OF MATERIALS WITH LIQUID OXYGEN NASA-TMX-53052 34P 5/26/64
 990001270 Y OF MATERIALS WITH LIQUID OXYGEN NASA-TMX-985 72P 8/64
 990002190 E-FLUIDS AND HIGH-PRESSURE OXYGEN NATIONAL SAFETY CONGRESS CHICAGO 7P PLUS 9P FIGURES PRESENTED BY W L
 990003030 INING LIQUID AND GASEOUS OXYGEN USAF-CONTRACT-AF33(616)6730 14P CRYOGENIC ENGINEERING CONFERENCE ANN
 990001410 WITH OXYGEN COMBUSTION IN OXYGEN AND SOXHELET ETHER-EXTRACTION MELKATH GARLUCK-900 APCI-ANAL-REP-70-026 AP
 990001330 TEMPERATURE IN 100-PERCENT OXYGEN ATM APCI-ANAL-REP-60-496 APCI-IWC-NU-81-0017 IP 1/6/61
 990002520 WNEY FIRE INCIDENT IN AN OXYGEN CLOUD FIRE JOURNAL PP70-8 AND 81 4P 1/71
 990001200 BROPHY, M. APCI COMPATIBILITY TESTS- MOLYLUBE-KOTE-AR AND MOLYLUBE-N APCI-K+D-NCTEBOOK-13
 990001370 HY, M. APCI HIGH-PRESSURE OXYGEN COMPATIBILITY TESTS WITH SILICONE-RUBBER GASKET COMPOUND- RTV-60-NP-134372-M
 990001130 WALDE, R.A. APCI GASEOUS OXYGEN COMPATIBILITY OF CROSSLITE FLUOROCARBON TAPE THREE-M-FLUOROCARBON-TAPE, PERM
 990001170 WALDE, R.A. APCI GASEOUS OXYGEN COMPATIBILITY TEST ON MULY-LUBE-NU-99 APCI-MEMO-63 66/11/63 IP
 990001110 DINANE, E. APCI OXYGEN COMPATIBILITY TESTS FOR VARIOUS MATERIALS- ABMA THREAD LUBRICANT AND SEALAN
 990001320 APCI KEL-F HIGH-PRESSURE OXYGEN COMPATIBILITY- NYLON APCI-MEMO-63 05/11/63 IP
 990000510 UMPATIBILITY OF MATERIALS- OXYGEN COMPATIBLE MATERIALS APCI-SAFETY-STD-609.1 8P 6/65
 990003380 ON AND EQUIPMENT ERECTION OXYGEN COMPRESSION SYSTEM EL/SEGUINDO/CALIF APCI-CONSTR-SPEC-200.0 TU 200.20 20
 990002600 BALL, W.L. APCI OXYGEN COMPRESSOR FIRE AT SSCP ROGNAC PLANT 3/2/71 APL-SAFETY-BULL-107 3P 4/1
 990003860 ANBA, J.S. APL BURKHARDT OXYGEN COMPRESSOR SUCTION APCI-MEMO-71 07/26/71 2P
 990004100 APL CENTRIFUGAL OXYGEN COMPRESSOR LOCATION APCI-DES-ENG-STD-570.6 2P 1/15/71
 990002910 G OF SCREENS TO BE USED IN OXYGEN COMPRESSOR SYSTEM APCI OPERATED APCI-DES-ENG-STD-570.7 32P 7/19/71
 990002560 APCI PIPING- OXYGEN COMPRESSOR LOCATION APCI-DES-ENG-STD-570.6 2P 1/15/71
 990000250 APCI PIPING- OXYGEN COMPRESSOR LOCATION APCI-DES-ENG-STD-570.6 2P 1/15/71
 990003090 DEMAG KA-27-IV/KA-4-IV OXYGEN COMPRESSORS APCI-DES-ENG-STD-570.6 2P 1/15/71
 990000270 LD TESTING AND CENTRIFUGAL OXYGEN COMPRESSORS APCI-DES-ENG-STD-551.2.8.1 18P 2/3/71
 990000260 TESTING AND RECIPROCATING OXYGEN COMPRESSORS APCI-DES-ENG-STD-551.1.9.1 14P 2/3/71
 990001080 F. APCI NOTES ON LIQUID OXYGEN CONTROL-PANEL APCI-DES-ENG-STD-534.1 (TO BE PUBLISHED)
 990002420 APCI SCHMOYER, W.W. APCI OXYGEN CYLINDER FAILURE APCI-SAFETY-GRAM-NU-13 2P 6/1/62
 990000050 AGRICULTURAL CHEMICAL CO OXYGEN FIRES AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-8 PPI
 990002620 MASTER, H.H. APCI OXYGEN FLOW-METER RING SEAL-FLUID APCI-MEMO-70 02/27/70 IP
 990001250 Y OF MATERIALS WITH LIQUID OXYGEN III NASA-TMX-53533 54P 11/3/66
 990001260 Y OF MATERIALS WITH LIQUID OXYGEN IV NASA-TMX-53773 50P 8/23/68
 990005990 APCI BURNING OF METALS IN OXYGEN ATROSPHERES (80 TO 100-PERCENT) APCI-TM-186 44P 3/72
 990003120 L.S. LATSHAW, D.R. APCI COMPATIBILITY WITH TWO-PART EPOXY-COMPOUND (7343-RESIN- 7139-CATALYST) FR
 990005990 PINA, A. FOSTER, P.H. APCI OXYGEN DIFFUSION IN THE ATMOSPHERE FROM LIQUID OXYGEN POOLS ADVANCES IN CPYC
 990006000 PINA, A. FOSTER, P.H. APCI OXYGEN DIFFUSION IN THE ATMOSPHERE FROM LIQUID OXYGEN POOLS CGA AIR-SEPARATI
 990003060 L.S. LATSHAW, D.R. APCI OXYGEN INDEX RATING SILICONE-O-RING (1/8-INCH DIA) APCI-IWO-NO-XD-0128 APCI
 990003090 L.S. LATSHAW, D.R. APCI OXYGEN INDEX RATING VITON-O-RING MATERIAL- VITON-E-60 (GREEN) VITON-A (BLACK) C
 990003350 IPLICATION FOR CLEANING FOR OXYGEN SERVICE APCI-590-SO-27A 5P 12/10/59
 990003360 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 500-PSIG-MAX-UMC CARBON-STEEL APCI-DES-ENG-STD-5
 990003310 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 275-PSIG-MAX CARBON-STEEL APCI-DES-ENG-STD-578.6
 990000350 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 720-PSIG-MAX CARBON-STEEL APCI-DES-ENG-STD-578.6
 990000300 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 150-PSIG-MAX CARBON-STEEL APCI-DES-ENG-STD-578.6
 990001860 STEEL PIPES IN A FLOWING OXYGEN STREAM APCI-MEMO-61 04/17/61 3P PLUS 7P ATTACHMENTS
 990002000 EL OF HYDROCARBON FILMS IN OXYGEN SYSTEMS AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-4
 990003880 NEL-PROTECTIVE SHIELDS FOR OXYGEN SYSTEMS APCI-18-42 3P 9/30/71 APPLICABLE TO APCI-DES-ENG-STD-546.1

990005970 COMPATIBILITY FOR GASEOUS OXYGEN SYSTEMS MAB-3266-69 9P 11/5/69
 990001900 SSCC INSTALLATION OF BULK OXYGEN SYSTEMS AT CONSUMER SITES-1965 NFPA-NO-566 10P 1965
 990001910 SSCC INSTALLATION OF BULK OXYGEN SYSTEMS AT CONSUMER SITES PROPOSED AMENDMENTS PART II AMENDMENTS TO N
 990000030 KITSON,F.K. APCI LIQUID OXYGEN LOADING APCI-SAFETY-GRAM-NO-06 IP 11/17/61
 990001890 Y OF MATERIALS WITH LIQUID OXYGEN METHYL-CHLORIDE, METHYLENE-CHLORIDE, CHLOROFORM, ETHYL-CHLORIDE, DICHLOROETH
 990002640 MASTER,H.H. APCI OXYGEN PIPE-LINE FAILURE APCI-MEMO-67 12/29/67 IP
 990005810 ELINE TRANSPORTATION- APL OXYGEN PIPELINE DESIGN CONCEPTS AND CRITERIA APCI-IIF2-2 1P 2/21/72
 990004040 PEGRAM,J.W. APL OXYGEN PIPELINES APL-ENGR-STU-LS-50/1 8P 7/1/70
 990001030 RECONSTRUCTED ICI TUNNAGE OXYGEN PLANT AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-5 P1-
 990002980 MATHEWS,L.G. LINDE OXYGEN PLANT EXPLOSION AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS
 990002960 ROTZLER,K.W. ET.AL OXYGEN PLANT REBOILER EXPLOSION AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA
 990002970 FOUNDRIES AND STEEL LTD OXYGEN PLANT VAPORIZER EXPLOSION AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA
 990003000 NERGY RELEASE IN A LIQUID OXYGEN PUMP AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-5 PP41
 990002610 BALL,W.L. APCI REPORT OF OXYGEN PUMP EXPLOSION AIRCO-BUTLER APCI-MEMO-63 10/21/63 IP PLUS 6P ATTACHMEN
 990003010 RENDUS,J.J. AIRCO LIQUID OXYGEN PUMP FAILURES AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS
 990002630 RENDUS,J.J. AIRCO LIQUID OXYGEN PUMP FAILURES RE-99000301
 990002340 APCI OXYGEN PUMP FILTER ASSEMBLY APCI-DRAWING-58521C REV-B 12/18/57
 990002860 APCI BYRON-JACKSON OXYGEN PUMP WASHOUT PROCEDURE FOR ANALYTICAL PURPOSES APCI-PUM-SEC-1.07 5P 7/
 990000140 SCHROYER,W.W. APCI OXYGEN REGULATORS IN THE WELDING INDUSTRY APCI-SAFETY-GRAM-NO-60C 5P 11/26/67
 990001100 ON,F.K. APCI ASSEMBLY OF OXYGEN REGULATORS T-FILM APCI-MEMO-61 11/30/61 IP
 990005940 APCI LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA- ACCIDENT/INCIDENT INVESTIGATION AND REPORT-APCI DOOCUME
 990002170 LATSHAW,D.K. APCI OXYGEN SAFETY REVIEW CHECK-LIST APCI-MEMO-71 05/4/71 3P
 990000940 N,F.K. APCI CLEANING FOR OXYGEN SERVICE APCI-MEMO-63 08/5/63 2P PLUS 9P ATTACHMENTS 4/4/67
 990000950 PRENT IN AIR PLANTS AND IN OXYGEN SERVICE APCI-PUM-SEC-1.08 7P PLUS 3P ATTACHMENTS 4/4/67
 990000780 -TUBE TYPE GAUGES USED FOR OXYGEN SERVICE APCI-GUAI-CONT-LAYOUT-102F 3P 7/1/71
 990000540 S- DEVIATIONS CLEANING FOR OXYGEN SERVICE APCI-SAFETY-STU-629.0.10 1P 6/19/61
 990000500 INSPECTION- MATERIALS AND OXYGEN SERVICE APCI-SAFETY-STU-608.1 7P 10/65
 990003760 AND DISCHARGING MANIFOLDS OXYGEN SERVICE APL-ENGR-SPEC-L-12.1 2P 7/7/69
 990003720 J.W. APL PRESSURE-GAUGE- OXYGEN SERVICE APL-ENGR-SPEC-J.07 3P 6/18/69
 990003700 AND TUBE-TYPE-COOLERS FOR OXYGEN SERVICE APL-ENGR-SPEC-E.05 13P 6/1/71
 990003730 SURE REGULATING-VALVES FOR OXYGEN SERVICE APL-ENGR-SPEC-J.15 3P 6/18/69
 990001980 SOC EQUIPMENT CLEANED FOR OXYGEN SERVICE CGA-PAMPHLET-G-4.1 21P 3/59
 990000960 R.E.J. APCI CLEANING FOR OXYGEN SERVICE 17P 1/60
 990003630 ASING ACCEPTANCE TESTS FOR OXYGEN SERVICE COMPRESSORS APL-ENGR-SPEC-K.02 3P 6/23/69
 990003690 YPE-COOLER, OTHER THAN FOR OXYGEN SERVICE (APL-PLANTS) APL-ENGR-SPEC-E.04 12P 6/1/71
 990003070 D-OXYGEN PUMPS ALUMINUM IN OXYGEN SERVICE LIQUID-CARBONIC-LIQUID-OXYGEN TRAILER- ACCIDENT VICTORY-MEMORIAL-HOS
 990003670 W. APL SPECIFICATION FOR OXYGEN SERVICE VESSEL FABRICATION APL-ENGR-SPEC-C.04 8P 7/26/71
 990000160 PRESSURE-VESSELS- GASEOUS OXYGEN STORAGE CYLINDER APCI-DES-ENG-STD-515.1.3 3P 10/17/60
 990003400 SCHROYER,W.W. APCI NASA OXYGEN STUDY PROJECT 00-1-2495.07 APCI-MEMO-71 12/10/71 IP
 990002950 TIONAL CYLINDER GAS CO OXYGEN TRAILER FIRE AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V
 990005700 APCI OPERATIONAL-HAZARDS- OXYGEN TRANSFER EQUIPMENT MALFUNCTIONS AND FAILURES COMPRESSORS AND PUMPS APCI-
 990003450 RACTICES USED FOR GASEOUS OXYGEN TRANSMISSION AND DISTRIBUTION CGA-DOCKET 70-11 CGA-THIRD DRAFT 23P 3/2
 990002010 E OF CUTTING OILS TO THEIR OXYGEN-COMPATIBILITY AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS
 990005640 D PIPELINE TRANSPORTATION OXYGEN-DISPERSAL FROM VENTS AND LINES APCI-IIF2C-1 1P 8/22/71
 990005650 WHICH OCCURRED WITH OTHER OXYGEN-EQUIPMENT APCI-IIF3-6 2P 2/3/72
 990005920 PARTS ACCIDENTS INVOLVING OXYGEN-EQUIPMENT AND SYSTEMS WHICH CAUSED INJURY TO PERSONNEL OR DAMAGE TO EQU
 990002420 TALLATION AND OPERATION OF OXYGEN-FUEL GAS SYSTEMS FOR WELDING AND CUTTING NFPA-NO-51 8P 1969 AND CUTTIN
 990000020 KITSON,F.K. APCI FIRE IN OXYGEN-LINE APCI-SAFETY-GRAM-NO-05 1P 10/20/61
 990003820 APL FIRE IN OXYGEN-LINE APL-SAFETY-BULL-028 1P 1/68
 990003870 IN HIGH-PRESSURE GASEOUS OXYGEN-LINE AT A CYLINDER FILLING DEPOT APL-SAFETY-BULL-114 3P 7/13/71
 990001870 -LIMITS OF CARBON STEEL IN OXYGEN-NITROGEN-ATMOSPHERES APCI-TMO-NO-LB-0043 APCI-TM-112 6P 5/8/69
 990000280 APCI PIPING- OXYGEN-PIPING APCI-DES-ENG-STD-578.60.1 14P 4/24/72
 990000710 ITY AND EXPLOSION HAZARDS- OXYGEN-PRESSURE-GAUGE Tnf MOBL, SPINTEX-305, MOLYKOTE-TYPE-2 AND TYPE-X-15 APCI-

990005900 APLICUS PROBLEMS RELATED TO OXYGEN-SAFETY APCI-IVE-2 IP 2/21/72
 990000250 NEL PROTECTIVE SHIELDS AND OXYGEN-SYSTEMS APCI-DES-ENG-STD-546.1 9P 1/15/71
 990000690 S AND THREAD COMPOUNDS FOR OXYGEN-SYSTEMS APCI-SAFETY-GRAM-NO-27 5P 3/22/63
 990005710 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER EQUIPMENT MALFUNCTIONS AND FAILURES GAS-PRESSURE-REGULATORS APCI
 990005580 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER SYSTEMS SYSTEMS- FIELD FABRICATED CRYGENIC LIQUID STORAGE TANKS
 990005590 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES VALVES APCI-IIF3A13-1 IP 12/30/71
 990005720 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES APCI INCIDENTS INVOLVING OXYGEN-TRANSFER-E
 990005680 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES INSULATION SYSTEM DUE TO VIBRATIONS DET
 990005690 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES GEISERING, EXCESSIVE VIBRATIONS, SHOCK (A
 990005730 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER MALFUNCTIONS AND FAILURES APCI-IIF3-1 IP 11/12/71
 990005590 SFEK SYSTEMS SYSTEMS- APL METHODS TYPICAL INSTALLATIONS, AND OPERATIONS DEPARTMENT OVERHAU
 990005610 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER PIPELINE-TRANSPORTATION PIPELINE TRANSPORTATION- APL OXYGEN PIPELI
 990005600 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER PIPELINE-TRANSPORTATION PIPELINE TRANSPORTATION- LIST OF STANDARDS
 990005570 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER PRODUCTION, STORAGE TO SYSTEM, STORAGE TO TRANSPORT, TRANSPORT TO
 990005560 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER PRODUCTION TO STORAGE, STORAGE TO SYSTEM, STORAGE TO TRANSPORT, T
 990005620 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE-TRANSPORTATION CONTAMINATION-CO
 990005640 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE-TRANSPORTATION PRESSURE-RELIEF
 990005660 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE TRANSPORTATION ROAD, RAILROAD,
 990005650 APCI OPERATIONAL-HAZARDS - OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE TRANSPORTATION ROAD, RAILROAD,
 990005680 S APCI INCIDENTS INVOLVING OXYGEN-TRANSFER-EQUIPMENT OR INSTRUMENTATION APCI-IIF3-2 2P 2/4/72
 990001300 Y IN 100-PERCENT GASEOUS OXYGEN FOAMSEAL-30-45-LIQUID, FLEXFAS-82-10-LIQUID, FLEXFAS-82
 990000440 OMPONENTS- AIR-SEPARATOR OXYGEN COMPRESSOR APCI-SAFETY-STD-607.1.2.3 6P 12/62
 990003960 RSON, I. APL EXPLOSION ON OXY-FUEL-BURNER EQUIPMENT AT ALCAN-BOUTH ALUMINIUM WORKS ROGERSTONE/NEWPORT 5/18
 990003130 L.G. LATSHAW, D.R. APCI OXY-TITE THREAD COMPOUND APCI IWO-ND-XD-0134 APCI-ANAL-REP-71-336 IP 10/22/71
 990004760 APCI GASKETS AND PACKINGS- FLUOROGREEN-E-600, JOHN/DOORE CO APCI-IA5A-04 IP 2/21/71
 990004790 APCI GASKETS AND PACKINGS- GARLOCK-900 (SHEET-ASBESTOS GASKET MATERIAL) GARLOCK MFG CO APCI-IA
 990004730 APCI GASKETS AND PACKINGS- GRAPHITE-IMPREGNATED-ASBESTOS-PACKING APCI-IA5A-01 IP 2/21/72
 990004857 APCI GASKETS AND PACKINGS- KLINGERIT-061 RICHARD KLINGER LTD/UK
 990004780 APCI GASKETS AND PACKINGS- KM220-SHEET ASBESTOS GASKET MATERIAL NICOLET INDUSTRIES INC APCI-IA5A
 990004810 APCI GASKETS AND PACKINGS- KM246 SHEET-ASBESTOS GASKET MATERIAL NICOLET INDUSTRIES APCI-IA5A-09
 990004770 APCI GASKETS AND PACKINGS- MELKATH-150 (SHEET-ASBESTOS GASKET MATERIAL) APCI-IA5A-05 IP 2/21/7
 990004840 APCI GASKETS AND PACKINGS- SINDANYO CS-51-ASBESTOS AND CEMENT BOARDS. NATURAL-UNTREATED-FINISH TUR
 990004820 APCI GASKETS AND PACKINGS- TEFLON, DUPONT APCI-IA5A-10 2P 2/21/72
 990004740 APCI GASKETS AND PACKINGS- TFE-GF-GREEN, MELRATH GASKETS CO APCI-IA5A-02 IP 2/21/72
 990004860 APCI GASKETS AND PACKINGS- TYGAFLOX CEMENTABLE PTFE TAPES TYGADURE LTD/UK APCI-IA5A-14 IP 2/
 990004750 APCI GASKETS AND PACKINGS- VALLEGREEN, VALLEYFORGE GASKET CO APCI-IA5A-03 IP 2/21/72
 990004830 APCI GASKETS AND PACKINGS- VITON-A DUPONT APCI-IA5A-11 IP 2/21/72
 990004800 APCI GASKETS AND PACKINGS- VULCANIZED-RED-FIBRE-GASKETS APCI-IA5A-08 IP 2/21/72
 990000880 IEMENTS FOR IPD SPECIFIED PAINT SYSTEMS APCI-QUAL-COMT-LAYOUT-120F 3P 7/1/71
 990003350 PREPARATION STANDARDS FOR PAINTING STEEL SURFACES ASTM-D2200-67 2P 1967
 990000390 APCI INSULATION AND PAINTING- COLD-BOXES THERMAL TANKS PERLITE APCI-DES-ENG-STD-581.1 4P 5/26/61
 990000410 APCI INSULATION AND PAINTING- COLD-BOXES, THERMAL TANKS, GLASS WOOL APCI-DES-ENG-STD-581.3 IP 10/24
 990000800 APCI INSULATION AND PAINTING- COLD-INSULATION AND MINERAL FIBER GRANULATEU APCI-DES-ENG-STD-581.2 2P
 990001890 NS, DOW-CORNING-SILICONE, PAINT-UN-GALBESTOS, DOW-CORNING-SILICONE-PAINT-XP-7-1003, GRIP-CLAD-PRIMEK, SHERWIN
 990003900 ACCIDENT AT T TURNER LTD PARK/LANE RUYTON LANCASTER 11940 AM 5/2/70 APL-SAFETY-DEPT-REP-30 (P
 990002070 STOMPLER, R.D. APCI PAUL, CARTER, AND CUSHDYNE LOX-PUMP SAFETY APCI-MEMO-71 1/01/26/71 2P
 990005230 -PERCENT ZN38.5-42-PERCENT P80.35-9-PERCENT APCI-IA6A-37 IP 2/21/72
 990001000 NITION-TESTS OF T-FILM AND PENTON APCI-MEMO-61 11/28/61 2P
 990000650 ULYBUTENE-GIL AMCCU-H-100, PENTON, T-FILM-THREAD COMPOUND APCI-MAR-87-0-8821 IP 11/61
 990000390 - COLD-BOXES THERMAL TANKS, PERLITE APCI-DES-ENG-STD-581.1 4P 5/26/61
 990004650 D ELECTRICAL INSULATIONS- PERLITE APCI-IA5A-05 IP 2/21/72

990003750 PEGRAM, J.W. APL EXPANDED PERLITE IN AIR-SEPARATION COLD-BOXES APCI-TB-39 IP 6/14/71
 990003760 TAYLOR, B.W. APCI USE OF PERLITE IN AIR-SEPARATION COLD-BOXES APCI-TB-39 IP 6/14/71
 990003780 ING COMPOUNDS- TEFLOON-TAPE APCI-IAZA-02 2P 2/21/72
 990003800 MICAL CO-CHESTER TOWN-MD., PERMACEL-RIBBON-DOPE PERMACEL-NEW/BUNSWICK/NEW JERSEY, WEST CONCRETE FLOOR TREATMENT
 990003810 FRISLAND-PLASTIC COMPANY, PERMACEL-TAPE APCI-ANAL-REP-60-49X61-3 APCI-IWO-NO-81-0018 IP 1/16/61
 990003830 THREE-M-FLUOROCARBON-TAPE, PERMACEL-TAPE APCI-MERU-63 07/30/63 IP
 990003850 PERMATEX SEALANT-1510- COMPATABILITY TESTS WITH HIGH-PRESSURE OXYGEN APCI-R+J-NOT
 990003870 S AND THREADING COMPOUNDS- PERMATEX-1516 APCI-IAZA-01 IP 2/21/72
 990003890 PERSONNEL PROTECTION-EQUIPMENT MAINTENANCE APCI-POM-1.12 7P 4/21/67
 990003910 TEM-EMERGENCIES PROTECTION APCI-IVCI-1 6P 1/13/72
 990003930 APCI CIVIL-STRUCTURAL- PERSONNEL PROTECTIVE SHIELDS FOR OXYGEN SYSTEMS APCI-DES-ENG-STD-546.1 9P 1/15/
 990003950 APCI PERSONNEL PROTECTIVE SHIELDS FOR OXYGEN SYSTEMS APCI-TB-42 3P 9/30/71 APPLICA
 990003970 SMITH, H.W. APCI PERSONNEL PROTECTIVE-EQUIPMENT- WEARING APPAREL HARD HATS APCI-SAFETY-STD-627.4
 990003990 SMITH, H.W. APCI PERSONNEL PROTECTIVE-EQUIPMENT- EYE PROTECTION APCI-SAFETY-STD-627.4-2 5P 10/6
 990004010 APCI PERSONNEL PROTECTIVE-EQUIPMENT- TUNNAGE AIR-SEPARATION PLANT APCI-SAFETY-STD-627.
 990004030 APCI PERSONNEL PROTECTIVE-EQUIPMENT- RESPIRATORY PROTECTIVE EQUIPMENT APCI-SAFETY-STD-627.
 990004050 APCI PERSONNEL PROTECTIVE-EQUIPMENT- ALUMINIZED HEAT PROTECTIVE CLOTHING APCI-SAFETY-S
 990004070 APCI PERSONNEL PROTECTIVE-EQUIPMENT- OCCUPATIONAL NOISE PROTECTIV
 990004090 OF MECHANICAL ENGINEERS PETROLEUM REFINERY PIPING ANSI-B31.3 104P 1966
 990004110 CA-LAMINATE BUNDED WITH A PHENOLIC RESIN, CUTTING-OILS, HEXADECANE, HYDROCARBON TYPE CUTTING-OILS, KNOWN AS T
 990004130 NEOPRENE, EPOXY-ADHESIVE, AND PHENOLIC-MOLDED, CUTTING-OILS, MELAMINE-MOLDED, POLYESTER-GLASS, NYLON, MOLYBDENUM-DISULFIDE, GRA
 990004150 NTAMINATED COMPONENTS, AND PICKLING OF CARBON-STEEL PIPE AND FITTINGS APCI-CONSTR-SPEC-200.16.1.7 TO 200
 990004170 ASTM STANDARD PICTORIAL SURFACE PREPARATION STANDARDS FOR PAINTING STEEL SURFACES ASTM-D2200-
 990004190 DS, AND EXPLOSION TESTING- PIPE AND MAPLE WOOD, ACTIVATED CARBON APCI-MAR-87-0-8821 IP 10/61
 990004210 CLEANING OF CARBON STEEL PIPE AND FITTINGS, CLEANING ALUMINUM-PIPE FITTINGS PARTS AND FABRICATIONS, CLEANI
 990004230 BROPHY, M. APCI PIPE BURNING TESTS APCI-R+O-NOTEBOOK-111 P26-9 4P 4/17/61
 990004250 F. APCI PIPING- APPROVED PIPE COATING THE PLASTIC TESTS MANUFACTURED BY PITTSBURGH CHEMICAL CO APCI-R+D
 990004270 BROPHY, M. APCI TARGET PIPE-DOPE APCI-MAR-87-0-8820 IP 9/61
 990004290 BOMB TEST, LED-PLATE-251, PIPE-DOPE APCI-MEMO-67 12/29/67 IP
 990004310 MASTER, H.H. APCI PIPE-LINE FAILURE DESIGN CONCEPTS AND CRITERIA APCI-IIF2-2 IP 2/21/72
 990004330 TRANSPORTATION- APL OXYGEN PIPELINE DESIGN CONCEPTS AND CRITERIA APCI-IIF2-1 IP 8/22/71
 990004350 ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION VEHICLE ACCIDENT PROCEDURES APCI-IIF20-1 IP
 990004370 ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION OXYGEN-DISPERSAL FROM VENTS AND LINES APCI-IIF2C-1 IP
 990004390 ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION VIBRATION AND CONTROLLED SLOSHING APCI-IIF2E-1 IP 9/
 990004410 ER PIPELINE-TRANSPORTATION PIPELINE TRANSPORTATION- LIST OF STANDARDS APCI-IIF2-1 2P 2/18/72
 990004430 ER PIPELINE-TRANSPORTATION PIPELINE TRANSPORTATION- APL OXYGEN PIPELINE DESIGN CONCEPTS AND CRITERIA APCI-
 990004450 NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS ESTABLISHMENT OF MINIMUM STANDARDS F
 990004470 NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS FILING OF INSPECTION AND MAINTENANCE PL
 990004490 NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS REQUIREMENTS FOR CORROSION CONTROL FE
 990004510 NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS MISC AMENDMENTS FEDERAL REGISTER V
 990004530 NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS EXTENSION OF TIME FOR CONFIRMATION OR
 990004550 NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS UDDORIZATION OF GAS FEDERAL REGISTER
 990004570 L-HAZARDOUS- OXYGEN-TRANSFER PIPELINE TRANSPORTATION- APL OXYGEN PIPELINE DESIGN CONCE
 990004590 L-HAZARDOUS- OXYGEN-TRANSFER PIPELINE TRANSPORTATION- LIST OF STANDARDS APCI-IIF2-1
 990004610 ELLULAR GLASS SECTION FOR PIPELINES APL-ENGR-SPEC-N.05 5P 10/17/70
 990004630 PEGRAM, J.W. APL OXYGEN PIPELINES APL-ENGR-STD-LS.30/1 8P 7/1/70
 990004650 L SAFETY-STANDARDS FOR GAS PIPELINES CORROSION-PITTING- NOTICE OF PUBLIC HEARING FEDERAL REGISTER VOL-36
 990004670 E. APCI BURNING OF STEEL PIPES IN A FLOWING OXYGEN STREAM APCI-MEMO-61 04/17/61 3P PLUS 7P ATTACHMENT
 990004690 PROCEDURE FOR DECREASING OF PIPEWORK APL-QCP-G11 REV.0 2P
 990004710 INEERS PETROLEUM REFINERY PIPING ANSI-B31.3 104P 1966
 990004730 ENGINEERS REFRIGERATION PIPING ANSI-B31.5 60P 1966
 990004750 SES CLEANLINESS OF OXYGEN PIPING APCI-I1B1-2 IP 2/19/72
 990004770 REDUCTION SPECIFICATION FOR PIPING ERECTION, TESTING AND CLEANING APL-ENGR-SPEC-M.02 9P PLUS APPENDIX I II
 990004790 REDUCTION SPECIFICATION FOR PIPING ERECTION, TESTING AND CLEANING APL-ENGR-SPEC-M.02 8P PLUS APPENDIX I II III

990003500 SMISION AND DISTRIBUTION ANSI-B31.8 106P 1968
 990003980 APL SOLVENT WASHING OF PIPING SYSTEMS APL-1G0-ENG-MAN-56-06 4P 7/3/71
 990003490 ES IN PRESSURE-VESSELS AND PUBLISHING CORP 427P 1965
 990004030 APL PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 720PSIG (CS07.2) APL-E
 990004060 APL PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 150PSIG (CS01.5) APL-E
 990004080 APL PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 500PSIG (CS05.0) APL-E
 990004070 APL PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 275PSIG (CS02.7) APL-E
 990001180 HIMMELBERGER, F. PEGRAM, J.W. PIPING- APPROVED PIPE THREAD SEALANTS APCI-DES-ENG-STD-570.5.1 1P 11/11/60
 990000320 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 500-PSIG-MAX-OWG CARBON-STEEL APCI-D
 990000300 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 150-PSIG-MAX CARBON-STEEL APCI-DES-E
 990000310 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 275-PSIG-MAX CARBON-STEEL APCI-DES-E
 990000330 APCI PIPING- DRY OXYGEN SERVICE -20F TO 100F 720-PSIG-MAX CARBON-STEEL APCI-DES-E
 990000350 APCI PIPING- EXTENDED BUNNET VALVE CODE APCI-DES-ENG-STD-579.4 3P 4/63
 990001830 APCI PIPING- INTRODUCTION HAND VALVE-CODE APCI-DES-ENG-STD-579.3 12P 1/63
 990002580 APCI PIPING- OXYGEN COMPRESSOR SYSTEM APCI OPERATED APCI-DES-ENG-STD-570.7 32P 7/
 990000290 APCI PIPING- OXYGEN COMPRESSOR LOCATION APCI-DES-ENG-STD-570.6 2P 1/15/71
 990000280 APCI PIPING- OXYGEN-PIPING APCI-DES-ENG-STD-578.60.1 14P 4/24/72
 990001680 APCI PIPING- PRESSURE RATING TABLES- PLAIN-AND-THREADED-ENDS- RED BRASS-PIPE APCI-DE
 990001740 APCI PIPING- PRESSURE RATING TABLES- PLAIN-AND-THREADED-ENDS- CARBON STEEL-PIPE APCI
 990001550 APCI PIPING- PRESSURE RATING TABLES- PLAIN-AND-THREADED-ENDS- STAINLESS STEEL-PIPE A
 990001610 APCI PIPING- PRESSURE RATING TABLES- PLAIN-AND-THREADED-ENDS ALUMINUM-PIPE APCI-DES-
 990000340 APCI PIPING- STAINLESS-STEEL VALVES AND MATERIAL REQUIREMENTS APCI-DES-ENG-STD-574.1
 990000370 APCI PIPING- TRANSITION-JOINTS AND ALUMINUM TO STAINLESS-STEEL APCI-DES-ENG-STD-579.3.1
 990000360 APCI PIPING- VALVE PROCUREMENT AND CLEANING PROCEDURE APCI-DES-ENG-STD-579.5 3P 8/1
 990001570 APCI PIPING-AA1.5- COLD-BOX-SERVICE 100F AND BELOW 150-PSIG-MAX-OWG ALUMINUM APCI-DE
 990001560 APCI PIPING-AA3- COLD-BOX-SERVICE 100F AND BELOW 300-PSIG-MAX-OWG ALUMINUM APCI-DES-
 990001710 APCI PIPING-CS14- GENERAL-SERVICE -20F TO 100F 1440-PSIG-MAX-OWG CARBON STEEL-PIPE
 990001840 APCI PIPING-CS1.5- GENERAL-SERVICE -20F TO 100F 150-PSIG-MAX-OWG CARBON STEEL-PIPE
 990001720 APCI PIPING-CS20- GENERAL-SERVICE -20F TO 100F 2000-PSIG-MAX-OWG CARBON STEEL-PIPE
 990001650 APCI PIPING-CS2.7- GENERAL-SERVICE -20F TO 100F 275-PSIG-MAX-OWG CARBON STEEL APCI-
 990001730 APCI PIPING-CS36- GENERAL-SERVICE -20F TO 100F 3600-PSIG-MAX-OWG CARBON STEEL APCI-
 990001700 APCI PIPING-CS7.2- GENERAL-SERVICE -20F TO 100F 720-PSIG-MAX-OWG CARBON STEEL-PIPE
 990001620 APCI PIPING-CT2- COLD-BOX-SERVICE 100F AND BELOW 200-PSIG-MAX-OWG COPPER-TUBE APCI-
 990001630 APCI PIPING-CT4- COLD-BOX-SERVICE 100F AND BELOW 400-PSIG-MAX-OWG COPPER-TUBE APCI-
 990003460 RELIEF VALVES LOCATION AND PIPING-DESIGN CONSIDERATIONS APCI PIPING GR3UP MEMO-19 10P 11/3/66
 990001590 APCI PIPING-IAA4- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 400-PSIG-M
 990001600 APCI PIPING-IAA9- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 900-PSIG-M
 990001660 APCI PIPING-ICT10- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 1000-PSI
 990001670 APCI PIPING-ICT23- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 2300-PSIG
 990001640 APCI PIPING-ICT4- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 400-PSIG-M
 990001650 APCI PIPING-ICT9- COLD-BOX-SERVICE-PROCESS-INSTRUMENT-PIPING 100F AND BELOW 900-PSIG-M
 990000650 IGNITION TEST METHOD, APL PIPING-RESIDUE, METHYLENE-CHLORIDE APCI-MAX-87-0-8821 1P 1/62
 990001770 APCI PIPING-SS12- COLD-BOX-SERVICE 100F AND BELOW 1235-PSIG-MAX-OWG STAINLESS STEEL-PI
 990001760 APCI PIPING-SS17- COLD-BOX-SERVICE 100F AND BELOW 1715-PSIG-MAX-OWG STAINLESS STEEL-PI
 990001750 APCI PIPING-SS2.7- COLD-BOX-SERVICE 100F AND BELOW 275-PSIG-MAX-OWG STAINLESS STEEL-PI
 990001790 APCI PIPING-SS30- COLD-BOX-SERVICE 100F AND BELOW 3000-PSIG-MAX-OWG STAINLESS STEEL-PI
 990001800 APCI PIPING-SS36- COLD-BOX-SERVICE 100F AND BELOW 3600-PSIG-MAX-OWG STAINLESS STEEL-PI
 990001760 APCI PIPING-SS6- COLD-BOX-SERVICE 100F AND BELOW 615-PSIG-MAX-OWG STAINLESS STEEL-PI
 990001810 APCI PIPING-SS7.2- COLD-BOX-SERVICE 100F AND BELOW 720-PSIG-MAX-OWG STAINLESS STEEL-PI
 990001820 APCI PIPING-SSL1.5- LUBE-OIL-SERVICE -20F TO 150F 150-PSIG-MAX STAINLESS STEEL-PI
 990000000 N,F,K. APCI ISOLATION OF PIPING-SYSTEMS APCI-SAFETY-GRAM-NO-21 1P 10/29/62
 990000460 NTS- AIR-SEPARATION PLANT, PIPING, VALVES AND SAFETY-RELIEF DEVICES APCI-SAFETY-STU-607.1.12 14P 10/62

990004870 URFACE TREATMENTS- TARGET PITTSBURGH CHEMICAL CO APCI-IA6A-01 IP 2/21/72
 990004890 ITC TESTS MANUFACTURED BY PITTSBURGH CHEMICAL CO APCI-R+D-NOTEBGOK-111 P129-32 4P 7/62
 990004900 LLULAR-GLASS) INSULATION, PITTSBURGH-CORNING CORP APCI-IA3A-01 IP 2/21/72
 990004910 SEALFAS-MASTIC-31-97-DRY, PITTSBURGH-CORNING CORP APCI-ANAL-REP-61-034 T
 990004920 PRESSURE RATING TABLES- PLAIN-AND-THREADED-ENDS ALUMINUM-PIPE APCI-DES-ENG-STD-571.1 5P 10/65
 990004930 PRESSURE RATING TABLES- PLAIN-AND-THREADED-ENDS- CARBON STEEL PIPE APCI-DES-ENG-STD-578.10.1 6P 10/65
 990004940 PRESSURE RATING TABLES- PLAIN-AND-THREADED-ENDS- FED BRASS PIPE APCI-DES-ENG-STD-572.1 5P 5/62
 990004950 PRESSURE RATING TABLES- PLAIN-AND-THREADED-ENDS- STAINLESS STEEL PIPE APCI-DES-ENG-STD-578.30.1 7P 5/62
 990004960 TRUCTED ICI TONNAGE OXYGEN PLANT AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-5 P1-15 15P
 990004970 KITSOR,F.K. APCI PLANT COMPONENTS- AIR-SEPARATION, OXYGEN, COMPRESSOR APCI-SAFETY-STD-607.1.2.3 6
 990004980 KITSOR,F.F. APCI PLANT COMPONENTS- AIR-SEPARATION PLANT, PIPING, VALVES AND SAFETY-RELIEF DEVICES
 990004990 SMITH,H. APCI PLANT COMPONENTS- AIR-SEPARATION PLANT, CRYOGENIC-LIQUID, AND DISPOSAL APCI-SAFET
 990005000 WILSON,H. APCI PLANT COMPONENTS- COLD-BOXES APCI-SAFETY-STD-607.1.5 7P 1/63
 990005010 BALL,W.L. APCI PLANT COMPONENTS- STORAGE, CONVERTER-SYSTEM, AND CRYOGENIC-LIQUIDS APCI-SAFETY-ST
 990005020 SCHMIDYER,W.W. APCI PLANT COMPONENTS- STORAGE, VACUUM-SYSTEMS, AND COMPRESSED-GASES APCI-SAFETY-STD-6
 990005030 ATHENS,L.G. LINDE OXYGEN PLANT EXPLOSION AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-3
 990005040 LINDE AIR-FRACTIONATION PLANT EXPLOSION AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-4
 990005050 LING, AND ANALYSIS APCI PLANT MANAGERS SAFETY MEETING-CREIGHTON/PENNSYLVANIA 19P 2/28/68 AND 3/20/68
 990005060 MASTER,H.H. APCI PLANT PREVENTIVE MAINTENANCE-CONTROL 9P PLUS EXHIBIT-A-1, A-2, A-3, A-4, A-5
 990005070 GTZLER,R.W. ET.AL OXYGEN PLANT REBOILER EXPLOSION AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLAN
 990005080 ES AND STEEL LTD OXYGEN PLANT SOLVENT WASHOUT-GENERAL APCI-PJM-SEC-1.05 12P 2/20/76
 990005090 S, KNOWN AS TYPE-GROUP-II, OXYGEN PLANT VAPORIZER EXPLOSION AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLA
 990005100 CRITERIA9 AIR-SEPARATION CHECK-LIST APCI-SAFETY-STD-605.1.3 6P 1/6/61
 990005110 BALL,W.L. APCI PLANT-SITE APCI-SAFETY-STD-610.1.1 5P 11/28/60
 990005120 ITY AND EXPLOSION HAZARDS- BALL,W.L. APCI PLANT-SITE CRITERIA- AIR-SEPARATION APCI-SAFETY-STD-605.1 9P 11/10/60
 990005130 ITY AND EXPLOSION HAZARDS- ITY AND EXPLOSION HAZARDS- 300 CELLULOSE-220 APCI-MAP-87-0-8822 1P 7/63
 990005140 ITY AND EXPLOSION HAZARDS- ITY AND EXPLOSION HAZARDS- 300, DTE-103, CELLULOSE-200 RECENT FIRES AT DUPONT
 990005150 SAFETY IN AIR AND AMMONIA PLANTS AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-2 PP31-36
 990005160 CTION FOR EQUIPMENT IN AIR APCI EXCHANGER, PLANTS AND IN OXYGEN SERVICE APCI-PJM-SEC-1.08 7P PLUS 3P ATTACHMENTS 4/4/67
 990005170 COMPONENTS- AIR-SEPARATION APCI EXCHANGER, PLANT, AND PLANT EQUIPMENT SOLVENT WASHOUT-FREQUENCIES APCI-PJM-SEC-5.07 3P 7/
 990005180 ER AS A LUBRICANT, TARGET, PLASITE APCI-MAR-87-0-8821 1P 7/62
 990005190 BRPHY,M. APCI PLASITE PROTECTIVE COATING APCI-MEMO-60 06/9/60 2P
 990005200 I TARGET PIPE-COATING THE HOUSING, AND RUBBER-HUSES PLASITE TESTS MANUFACTURED BY PITTSBURGH CHEMICAL CO APCI-R+D-NOTEBGOK-111 P1
 990005210 S, AND SURFACE TREATMENTS- PLASITE-NO-7122H APCI-MAR-87-0-8820 1P 6/60
 990005220 VEG GLASS-FIBER-REINFORCED PLASITE-NO-7122H WISCONSIN PROTECTIVE COATING CO APCI-IA6A-03 1P 2/21/72
 990005230 NO GEON POLYVINYLCHLORIDE, APCI PLASTIC LEAD SEAL-NO-2-JOHN CRANE APCI-MEMO-59 01/28/59 2P
 990005240 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- KEENE-BINDER APCI-IA4A-02 1P 2/21/72
 990005250 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- RTV-60, SILICONE-RUBBER COMPOUND WITH SS-4004-
 990005260 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- NYLON-66 ICI LTD/UK APCI-IA4A-07 1P 2/21/
 990005270 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- NEOPRENE APCI-IA4A-05 1P 2/21/72
 990005280 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- VITON-A DUPONT APCI-IA4A-06 1P 2/21/72
 990005290 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- KEL-F-81 APCI-IA4A-03 1P 2/21/72
 990005300 APCI PLASTICS, ELASTOMERS, AND ADHESIVES- NYLON APCI-IA4A-04 1P 2/21/72
 990005310 APCI PNEUMATIC TESTING-GENERAL APCI-QUAL-COUNT-LAYOUT-105A 3P 7/1/71
 990005320 TION TESTING- EPUN-H-60, AND STYRUFOAM, LUBRICANTS, MOLY-SPRAY-KOTE, AND DRI-LUBE APCI-MAR-8
 990005330 TON A VINYLIDENO FLUORIDE, POLYDIMETHYLSILOXANE, FLUORINATED-SILOXANE, LS-53, BUTYL-RUBBER, IRON-OXIDES, TALC,
 990005340 US, AND EXPLOSION TESTING- POLYESTER RESIN IMPREGNATED FIBERGLASS LAVA APCI-MAR-87-0-8821 1P 3/62
 990005350 C-MOLDED, MELAMINE-MOLDED, POLYESTER-GLASS, NYLON, MOLYBDENUM-DISULFIDE, GRAPHITE, ELECTROFILM-SPRAYABLE-A, OK

990001500 BROPHY, M. APCI PLASITE PROTECTIVE COATING APCI-MEMO-60 06/9/66 2P
 990002250 CIVIL-STRUCTURAL- PERSONNEL PROTECTIVE SHEETS AND OXYGEN-SYSTEMS APCI-DES-ENG-STD-546.1 9P 1/15/71
 990001890 REM, ZYGLO-ZP-5-DEVELOPER, PROTECTIVE-COATINGS, DOW-CORNING-SILICONE, PAINT-DR-GALBESTOS, DOW-CORNING-SILICONE
 990003350 REVISION-PITTING- NOTICE OF PUBLIC HEARING FEDERAL REGISTER VOL-36 NO-126 6/30/71
 990003000 RELEASE IN A LIQUID OXYGEN PUMP AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-5 PP41-42 19
 990002610 L. APCI REPORT OF OXYGEN PUMP EXPLOSION AIRCO-BUTLER APCI-MEMO-63 10/21/63 1P PLUS 6P ATTACHMENTS
 990004210 NTU BURCKHARDT CENTRIFUGAL PUMP EXPLOSION AND TANKER FIRE AT SHEEPBRIDGE ALLOY CASTINGS LTD APL-MEMO-64
 990003010 J.J. AIRCO LIQUID OXYGEN PUMP FAILURES AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-9 P5
 990000110 CHMURER, W.W. APCI VACUUM PUMP FAILURES APCI-SAFETY-GRAM-NU-35 1P 10/4/63
 990002630 J.J. AIRCO LIQUID OXYGEN PUMP FAILURES RE-99000301
 990002340 APCI OXYGEN PUMP FILTER ASSEMBLY APCI-DRAWING-58521C REV-B 12/16/57
 990002660 R.H.H. APCI LDX TRANSFER PUMPS SCREENS APCI-MEMO-69 01/24/69 2P PLUS 3P ATTACHMENTS
 990002860 APCI BYRON-JACKSON OXYGEN PUMP WASHOUT PROCEDURE FOR ANALYTICAL PURPOSES APCI-PUM-SEC-1.07 5P 7/7/70
 990001070 ESTS OF OIL FROM ALIQUIPPA PUMP-SUCTION FILTER DEFROST AND OF METHYLENE-CHLORIDE APCI-MEMO-61 12/11/61 2P
 990000640 CARBON-DISULFIDE ALIQUIPPA PUMP-SUCTION-FILTER-DEFROST CYL-SEAL SEALING COMPOUND APCI-MAR-87-0-8821 1P 12/
 990003890 MARKS STEEL WURKS/SHOTTON PUMP-TYPE-GB114-SERIAL-NU-79 APL-SAFETY-DEPT-REP-26 6P 1/15/70
 990005590 HAUL PROCEDURES FOR LIQUID PUMPS APCI-IIF1-4 1P 2/21/72
 990005700 FAILURES COMPRESSORS AND PUMPS APCI-IIF3-4 15P 1/23/72
 990002650 R.H.H. APCI LDX TRANSFER PUMPS APCI-MEMO-68 12/30/68 2P PLUS 2P ATTACHMENTS
 990002760 ON, F.K. APCI WASH VACUUM PUMPS APCI-MEMO-71 01/19/71 2P
 990003710 APL CENTRIFUGAL CRYOGENIC PUMPS APL-ENGR-SPEC-G.03 14P 4/1/71
 990003070 5/11-12/71 LIQUID-OXYGEN PUMPS ALUMINUM IN OXYGEN SERVICE LIQUID-CARBONIC-LIQUID-CYXEN TRAILER- ACCIDENT VI
 990002690 FIRE TESTS ON CENTRIFUGAL PUMPS FOR LIQUID-OXYGEN CRYOGENICS V-10 PP241-248 8P 6/70
 990004150 CHAMBERS, J. APL PURGE PROCEDURE FOR CRYOGENIC LIQUID CONTAINER APL-16D-ENGR-MAN-52-02 7P 6/3/7
 990001120 ENT, W.L. APCI PUTTI-ROPE ANALYSIS FOR OIL CONTENT AND FLAMMABILITY TEMPERATURE APCI-MEMO-59
 990004500 S AND THREADING COMPOUNDS- PUTTI-ROPE NATIONAL GREENHOUSE CO APCI-IAZA-04 1P 2/21/72
 990001400 E-F-50, SF811401-SILICONE, PYDRAUL-F-9, DOW-CORNING-4 COMPOUND SILICONE, DOW-CORNING-4X COMPOUND-SILICONE, FAI

990002110 OF MECHANICAL ENGINEERS QUALIFICATION STANDARD FOR WELDING AND BRAZING PROCEDURES, WELDERS, BRAZERS, AND
 990005650 ELINE-TRANSPORTATION ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION VEHICLE ACCIDENT PROCEDURES APCI-II
 990005600 ELINE-TRANSPORTATION ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION VIBRATION AND CONTROLLED SLOSHING
 990005640 ELINE-TRANSPORTATION ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION OXYGEN-DISPERSAL FROM VENTS AND LINE
 990000660 YURETHANE-FOAM-INSULATION, AND IMPREGNATED ASBESTUS-KUPE MATERIAL APCI-MAR-87-
 990001520 ELLE MEMORIAL INSTITUTE REACTIVITY OF METALS WITH LIQUID AND GASEOUS OXYGEN AD297124 DMIC-MEMO-163
 990002950 K.W. ET, AL OXYGEN PLANT REBOILER EXPLOSION AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-
 990003370 GENERAL SPECIFICATION FOR RECIPROCATING COMPRESSORS APCI-550-SD-01A 37P 3/9/64
 990000260 CHINERY- FIELD TESTING AND RECIPROCATING OXYGEN COMPRESSORS APCI-DES-ENG-STD-551.1.9.1 14P 2/3/71
 990001510 - PLAIN-AND-THREADED-ENDS- RED BRASS-PIPE APCI-DES-ENG-STD-572.1 5P 5/62
 990002890 TRUCTIONS FOR AIR-PRODUCTS RED-SET WELDING AND CUTTING OUTFITS APCI-BROCHURE 11P 9/25/69
 990004920 S, AND SURFACE TREATMENTS- RED-BRASS-PIPE ASTM-B43 APCI-1A6A-06 1P 2/21/72
 990000100 IFF THOSE CYLINDERS BEFORE REFILLING APCI-SAFETY-GRAM-NU-31 2P 8/21/63
 990003470 ICAL ENGINEERS PETROLEUM REFINERY PIPING ANSI-B31.3 104P 1960
 990003480 OF MECHANICAL ENGINEERS REFRIGERATION PIPING ANSI-B31.5 60P 1960
 990003490 RESURE-VESSLS AND PIPING REINHOLD PUBLISHING CORP 427P 1965
 990001960 KESSED GAS ASSOC SAFETY RELIEF DEVICE STANDARDS PART-1- CYLINDERS FOR COMPRESSED GASES CGA-PAMPHLET-S-
 990000240 AL REQUIREMENTS SAFETY AND RELIEF VALVES APCI-DES-ENG-STD-537.9 4P 7/65
 990003460 APCI SAFETY RELIEF VALVES LOCATION AND PIPING DESIGN CONSIDERATIONS APCI PIPING GROUP MEMO
 990003740 PEGRAM, J.W. APL REPAIRS APCI-PUM-SEC-6.09 4P 11/29/68 FOR ATTCHMTS SEE 205 206 207
 990002040 APCI CODED VESSEL REPAIRS APCI-PUM-SEC-6.09 4P 11/29/68 FOR ATTCHMTS 11/29/68
 990002280 APCI CODED VESSEL REPAIRS APCI-PUM-SEC-6.09 4P 11/29/68 FOR ATTCHMTS 11/29/68
 990000770 PLOSION TESTING- POLYESTER RESIN IMPREGNATED FIBERGLASS LAVA APCI-MAR-87-0-8821 1P 3/62
 990000750 TE BUNDED WITH A PHENOLIC RESIN, CUTTING-OILS, HEXADECANE, HYDROCARBON TYPE CUTTING-OILS, KNOWN AS TYPE-GFOJP
 990003220 NNEL-PROTECTIVE-EQUIPMENT- RESPIRATORY PROTECTIVE EQUIPMENT APCI-SAFETY-STD-627.3 14P 1/704

99000485/ ND PACKINGS- KLINGERKIT-601 RICHARD KLINGER LTD/UK
 990002730 APCI OXYGEN FLOW-METER RING SEAL-FLUID APCI-MEMO-70 02/27/70 1P
 990004250 ROUGH HANTS ENGLAND FIRE RISKS TO MAN OF OXYGEN RICH GAS ENVIRONMENT'S EPRC/MEMO-223 12P 7/65
 990005030 L-HAZARDS- OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE-TRANSPORTATION CONTAMINATION-CONTROL APCI-11F
 990005060 L-HAZARDS- OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE-TRANSPORTATION ROAD, RAILROAD, BARGE AND PIPEL
 990005090 L-HAZARDS- OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE-TRANSPORTATION ROAD, RAILROAD, BARGE AND PIPEL
 990005640 L-HAZARDS- OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE-TRANSPORTATION ROAD, RAILROAD, BARGE AND PIPEL
 990005660 L-HAZARDS- OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE-TRANSPORTATION ROAD, RAILROAD, BARGE AND PIPEL
 990005620 L-HAZARDS- OXYGEN-TRANSFER ROAD RAILROAD BARGE AND PIPELINE-TRANSPORTATION PRESSURE-RELIEF APCI-11F2A-1
 990005990 INACTION OF STATIC-TANK AND ROAD-VEHICLE-ASSEMBLIES FOR OXYGEN SERVICE APL-CCP-010 REV.0 2P
 990005650 D PIPELINE-TRANSPORTATION ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION VEHICLE ACCIDENT PROCEDURES A
 990005660 D PIPELINE-TRANSPORTATION ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION VIBRATION AND CONTROLLED SLOSH
 990005640 D PIPELINE TRANSPORTATION ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION OXYGEN-DISPERSAL FROM VENTS AND
 990001450 APCI QUALITY CONTROL OF ROCK WOOL APCI-MEMO 2 HIMMELBERGER,F. APCI QUALITY CONTROL OF ROCK WOOL AP
 990001450 APCI QUALITY CONTROL OF ROCK WOOL APCI-MEMO-59 11/6/59 2P
 990001470 FR.E. APCI PRODUCTION OF ROCK WOOL BETHLEHEM-STEEL-CO APCI-MEMO-59 11/12/59 2P
 990000010 - TURN A CYLINDER INTO A ROCKET APCI-SAFETY-GRAM-NU-04C 1P 8/1/61
 990003960 CAN-BODTH ALUMINIUM WORKS ROGERSTONE/NEWPORT 5/18/71 APL-SAFETY-DEPT-REP-37 7P 6/2/71
 990003880 EN COMPRESSOR FIRE AT SSPC KOGNAC PLANT 3/2/71 APL-SAFETY-BULL-107 3P 4/14/71
 990001370 NE-RUBBER GASKET COMPOUND RTV-60-NE-134372-M235 APCI-R+D-NCTEBOOK-111 1P149 1P 1/63
 990004660 ELASTOMERS, AND ADHESIVES- RUBBER-HOSES PLASTIC-NU-1122H APCI-MAR-87-0-8820 1P 6/60
 990003140 KITSUN,F.K. APCI RUBTURE DISCS MANUFACTURED LGX TANKERS BY AMETEK APCI-MEMO-71 06/22/71 1P
 990002300 APCI SAFETY-VALVES AND RUPTURE-DISCS APCI-POM-SEC-0-032 19P INCLUDING EXHIBITS ABCDE 12/8/64
 990001110 AND SEALANT, ANDERJUL-L-536 RUPT-PREVENTIVE LEHIGH CHEMICAL CO-CHESTERUM-ND., PERMACEL-RIBBON-DOPE PERMACEL

990005820 APCI MAINTENANCE PROGRAM SAFE CLEANING PROCEDURES FOR FILTERS, TRAPS, AND INSTRUMENTS APCI-111B-1 2P 11/
 990002710 COMPRESSED GAS ASSOC SAFE HANDLING OF COMPRESSED GASES CGA-PAMPHLET-P-1 10P 1965
 990002830 APCI SAFE HANDLING OF CRYOGENIC LIQUIDS AND ASSOCIATED EQUIPMENT APCI-POM-SEC-1-117 8
 990002700 SCHMOYER,H.W. APCI SAFE HANDLING OF REGULATORS AND TORCHES APCI-PAPER 17P PLUS 2P ATTACHMENTS 7/
 990002150 N OF FRACTURE-MECHANICS TO SAFE-LIFE DESIGN IN CRYOGENIC PRESSURE-VESSELS ESSO-REPORT-ND-EE-26ER.70 17P 8
 990006010 APCI CRYOGENIC SAFETY CONFERENCE ALLENTOWN 145P 7/59
 990002670 ER, AND COSMODYNE LOX-PUMP SAFETY APCI-MEMO-71 1/01/26/71 2P
 990002680 MPLER,R.D. APCI LOX-PUMP SAFETY APCI-MEMO-71 2/19/71 1P
 990002240 TIGN- SPECIAL REQUIREMENTS SAFETY AND RELIEF VALVES APCI-DES-ENG-STD-537.9 4P 7/65
 990001030 CHEMICAL INDUSTRIES LTD SAFETY ASPECTS OF RECONSTRUCTED ICI TONNAGE OXYGEN PLANT AICHE-CEP-TECH-MANUAL S
 990000230 SHING PRESSURE-SETTINGS OF SAFETY DEVICES APCI-DES-ENG-STD-537.1 6P 4/21/59
 990002740 I TESTS OF PRESSURE-GAGES SAFETY EQUIPMENT NEVER PREVENTS AN ACCIDENT- IT ONLY PREVENTS AN INJURY APCI-SA
 990003160 SMITH,H.W. APCI SAFETY GLASSES SAVE ANOTHER PAIR OF EYES APCI-SAFETY-GRAM-NG-01 1P 6/11/61
 990003170 CI PRESSURE-GAUGE FAILURE SAFETY IN AIR AND AMMONIA PLANTS AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMON
 990002950 IAL CHEMICAL INDUSTRIES SAFETY IN WELDING AND CUTTING USAS-249.1 49P 1967
 990002720 MERICAN WELDING SOCIETY SAFETY IN WELDING AND CUTTING USAS-249.1 49P 1967
 990002860 APCI OPERATING AND SAFETY INSTRUCTION FOR REGULATORS AND COMPRESSED GASES APCI-BROCHURE 4P 4/70
 990002020 APCI SAFETY CONTROL PROCEDURE- SAFETY WORK-PERMIT APCI-POM-SEC-1-1.04 3P PLUS EXHIBIT 4/70
 990002030 APCI SAFETY CONTROL PROCEDURE- TAG CUT APCI-POM-SEC-1.63 2P PLUS EXHIBIT-A 1P 2/
 990000530 APCI SAFETY CONTROL PROCEDURE- EMERGENCY PROCEDURES APCI-SAFETY-STD-626.3.8 8P 5/6
 990002080 APCI SAFETY CONTROL PROCEDURE- TAG OUT PROCEDURE APCI-SAFETY-STD-626.3.3 8P 5/6
 990002400 SMITH,H.W. APCI SAFETY CONTROL PROCEDURE- PURGING METHODS APCI-SAFETY-STD-026.4.1 7P 1/70 2/7
 990002050 SMITH,H.W. APCI SAFETY CONTROL PROCEDURE- AIR-SEPARATION-PLANT SAFETY WORK PERMITS APCI-SAFET
 990002510 CI PRODUCT VAAPR HAZARDS- SAFETY INFORMATION RELATIVE TO LIQUID-VAAPR-CLOUDS APCI-PAPER 7P 1971
 990003300 APCI OPERATIONS SAFETY MANUAL APCI-SAFETY MANUAL-20P+4 88P 1964 (OUT OF PRINT)
 990003390 SAFETY PANEL CRYOGENICS SAFETY MANUAL P122 1970
 990003020 1 TU DISCUSSED LIQUID-OXYGEN SAFETY REGULATIONS 3P 5/13/71 PLUS NOTES ON VISIT TU HMS ARK-ROYAL FN 11/8/71
 990003150 COMPRESSED GAS ASSOC SAFETY RELIEF DEVICE STANDARDS PT-3 COMPRESSED-GAS STORAGE-CONTAINERS CGA-PAM
 990005940 LIQUID AND GASEOUS OXYGEN SAFETY REVIEW DATA- ACCIDENT/INCIDENT INVESTIGATION AND REPORT-APCI DOCUMENTS LIS

990002170 LATSHAW,D.R. APCI OXYGEN SAFETY REVIEW CHECK-LIST APCI-MEMO-71 05/4/71 3P
 990004050 GRAM,J.W. APL DESIGN AND SAFETY SATNDAPDS FOR CARBON-STEEL GASEOUS OXYGEN TRANSMISSION-LINES APL-ENGR-S
 990005850 APCI SYSTEM-EMERGENCIES SAFETY TRAINING AND AREA PLACARDING APCI-IVA-1 4P 11/5/71
 990002050 URES- AIR-SEPARATION-PLANT SAFETY WORK PERMITS APCI-SAFETY-STD-626.3.5 3P 6/19/61
 990003020 AL ON 11/8/71 TO DISCUSS SAFETY OF SHIPBOARD LOX-PLANTS 2P 9/13/71
 990001960 COMPRESSED GAS ASSOC SAFETY RELIEF DEVICE STANDARDS PART-1- CYLINDERS FOR COMPRESSED GASES CGA-PAMP
 990003460 APCI SAFETY RELIEF VALVES LOCATION AND PIPING-DESIGN CONSIDERATIONS APCI PIPING GROU
 990002330 APCI SAFETY REPORTS AND FORMS APCI-POM-SEC-5.18 6P PLUS EXHIBITS ABCDEFGH 3/3/70
 990003210 APCI WEAR SAFETY SHOES APCI-SAFETY-GRAM-NO-11 2P 5/14/62
 990001350 BROPHY,M. APCI SAFETY TESTS UNDER WD-81-0095 HYLOMAR-UNIVERSAL-JOINTING COMPOUND SQ-32 AND VITON
 990001850 CI COULD TEST OF 1/2-INCH SAFETY VALVE WITH CARBON STEEL SPRING APCI-IWO-NO-10-7071 APCI-PROJECT-NO-00-5-
 990002030 SAFETY CONTROL PROCEDURE- SAFETY WORK-PERMIT APCI-POM-SEC-1.04 3P PLUS EXHIBIT-A 1P 2/16/67
 990001970 APCI FLEET SAFETY- FIRE EXTINGUISHMENT APCI-SAFETY-STD-635.30 5P 2/68
 990001940 APCI FLEET SAFETY- LOADING AND UNLOADING OPERATIONS APCI-SAFETY-STD-635.19 6P 2/68
 990003270 MPLER,R.D. APCI LOX-PUMP SAFETY-BARRIERS APCI-MEMO-71 02/19/71 2P
 990003290 BALL,W.L. APCI ARE SAFETY-GLASSES WORTH THE COST AND EFFORT APCI-SAFETY-GRAM-NO-30 1P 8/9/63
 990002410 ALL,W.L. APCI INDUSTRIAL SAFETY-INDUSTRIAL SAFETY POLICY APCI-SAFETY-STD-625.0.1 13P 10/3/61
 990000460 PLANT, PIPING, VALVES AND SAFETY-RELIEF DEVICES APCI-SAFETY-STD-607.1.12 14P 10/62
 990003510 PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS ESTABLISHMENT OF MINIMUM STANDARDS FEDERAL REGISTER VOL-35
 990005570 PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS EXTENSION OF TIME FOR CONFIRMATION OR REVISION OF MAXIMUM ALLOWA
 990003520 PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS FILING OF INSPECTION AND MAINTENANCE PLANS FEDERAL REGISTER V
 990003550 E SAFETY MINIMUM FEDERAL SAFETY-STANDARDS FOR GAS PIPELINES CORROSION-PITTING- NOTICE OF PUBLIC HEARING F
 990003540 PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS MISC AMENDMENTS FEDERAL REGISTER V-35 N-223 11/17/70
 990003530 PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS OODRIZATION OF GAS FEDERAL REGISTER VOL-35 NO-220 11/11/70
 990003560 PIPELINE- MINIMUM FEDERAL SAFETY-STANDARDS REQUIREMENTS FOR CORROSION CONTROL FEDERAL REGISTER VOL-36 N
 990001210 MLYSAN,S.R. APCI SAFETY-VALVE-SEAT OXOMAT FLAMMABILITY IN 100-PERCENT GASEOUS OXYGEN APCI-ANAL-R
 990002300 APCI SAFETY-VALVES AND RUPTURE-DISCS APCI-POM-SEC-6.02 19P INCLUDING EXHIBITS ABCDE
 990000660 FOSTER,R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- IGNITION TEST-APPARATUS, FLORUBE-GREASES, E
 990000640 KEHAT,E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- CS2 CARBON-DISULFIDE ALIQUIPPA PUMP-SUCTION
 990000690 FOSTER,R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- HOUDRY FOAM INSULATION, AND HAVEG GLASS-FIB
 990000630 KEHAT,E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- SILICON-OILS DOW-CURNING-RF-1-0065, SILICON
 990000650 HAT,E. FOSTER,R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- STANDARD IGNITION TEST METHOD, APL PIPING-R
 990000620 KEHAT,E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- PINE AND MAPLE WOOD, ACTIVATED CARBON APC
 990000610 KEHAT,E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- SPARK-IGNITION, STANDARD BOMB TEST, LED-PLA
 990000670 FOSTER,R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- POLYESTER RESIN IMPREGNATED FIBERGLASS LAV
 990000660 FOSTER,R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- EPON-H-60, POLYCEL-440R, AND STYROFOAM, LUB
 990000690 KEHAT,E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- UCON-TYPE LUBRICANTS, STEEL-PIPES APCI-MA
 990000660 KEHAT,E. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- STANDARD PRESSURE BOMBS AND SPARK-IGNITION,
 990000700 FOSTER,R.H. APCI SAFETY, HAZARDS, AND EXPLOSION TESTING- TALCUM-POWDER AS A LUBRICANT, TARSET, PLASI
 990000970 NT CONTAMINATION- HISTORY, SAMPLING, AND ANALYSIS APCI PLANT MANAGERS SAFETY MEETING-CRUGHTON/PENNSYLVA
 990001150 ESCENCE DAMCO-TEFLON TAPE, SANDEM-INDUSTRIAL, CRANE PACKING CO APCI-ANAL-REP-70-368,70-369 1P 10/7/70
 990004540 S AND THREADING COMPOUNDS- SANDEN TAPE APCI-IA2A-08 2P 2/21/72
 990000900 NING LOX STORAGE TANK-NO-6 SANTA/SUSANA APCI-MEMO-64 03/11/64 1P PLUS 1P ATTACHMENT
 990002660 APCI LOX TRANSFER PUMP SCREENS APCI-MEMO-69 01/24/69 2P PLUS 3P ATTACHMENTS
 990002910 LAPIN,A. APCI TESTING OF SCREENS TO BE USED IN OXYGEN COMPRESSOR SUCTION APCI-MEMO-71 07/26/71 2P
 990001190 W. APCI REGULATOR THREAD SEALANT MOLYLUBE-N APCI-MEMO-63 10/4/63 1P
 990001220 BROPHY,M.+ APCI PERMATEX SEALANT-1516- COMPATABILITY TESTS WITH HIGH-PRESSURE OXYGEN APCI-R+D-NCTEBDUK-111
 990001180 PING- APPROVED PIPE THREAD SEALANTS APCI-DES-ENG-STD-570.5.1 1P 11/11/60
 990004470 APCI SEALANTS AND THREADING COMPOUNDS- PERMATEX-1516 APCI-IA2A-01 1P 2/21/72
 990004520 APCI SEALANTS AND THREADING COMPOUNDS- CROSSLITE-FLUOROCARBON-TAPE APCI-IA2A-06 2P 2
 990004570 APCI SEALANTS AND THREADING COMPOUNDS- THREE-M FLUOROCARBON-TAPE APCI-IA2A-11 2P 2/2
 990004550 APCI SEALANTS AND THREADING COMPOUNDS- CRANE PACKING CO-TAPE APCI-IA2A-09 2P 2/21/
 990004500 APCI SEALANTS AND THREADING COMPOUNDS- PUTTI-ROPE NATIONAL GREENHOUSE CO APCI-IA2A-0
 990004490 APCI SEALANTS AND THREADING COMPOUNDS- T-FILM ECO MFRG CO APCI-IA2A-03 1P 2/21/72

990004530 APCI SEALANTS AND THREADING COMPOUNDS- DAMCO TAPE APCI-IA2A-07 2P 2/21/72
 990004540 APCI SEALANTS AND THREADING COMPOUNDS- TEFLON TAPE PERMACEL APCI-IA2A-02 2P 2/21/72
 990004540 APCI SEALANTS AND THREADING COMPOUNDS- SANDEN TAPE APCI-IA2A-08 2P 2/21/72
 990004560 APCI SEALANTS AND THREADING COMPOUNDS- MOLYLUBE-N BEL-RAY CU FARMINGDALE/NJ APCI-IA2
 990004580 APCI SEALANTS AND THREADING COMPOUNDS- OXYMAT APCI-IA2A-10 IP 2/21/72
 990001110 ABMA THREAD LUBRICANT AND SEALER- ANDERSON L-536 RUST-PREVENTIVE LEHIGH CHEMICAL CO-CHESTER TOWN-MO., PERMACEL APCI-IA2A-
 990001160 SEAL THREAD LUBRICANT AND SEALER- TAPE SEAL FROM FRIELAND-PLASTIC COMPANY, PEP MACEL TAPE APCI-ANAL-REP-60
 990004880 SEALFAS-MASTIC-31-97 BENJAMIN FOSTER CU APCI-IA6A-02 IP 2/21/72
 990001300 ALFAS-MASTIC-31-97-LIQUID, SEALFAS-MASTIC-31-97-DRY, PITTSSEAL-III-LIQUID, POROUS-INSULATING-MATERIAL FDM GLAS
 990001300 LIQUID, FLEXFAS-82-10-DRY, SEALFAS-MASTIC-31-97-LIQUID, SEALFAS-MASTIC-31-97-DRY, PITTSSEAL-III-LIQUID, POROUS-
 990000640 UN-FILTER-DEFROST CYL-SEAL SEALING COMPOUND APCI-MAR-87-0-8821 IP 12/61
 990001300 OXYGEN FLOW-METER RING SEAL-FLUID APCI-MEMO-70 02/27/70 IP
 990002730 INYLCHLORIDE, PLASTIC LEAD SEAL-NO-2-JOHN CRANE APCI-MEMO-59 01/28/59 2P
 990001110 UCTS INC, ALUMINUM-OXIDE, SEAM COMPOUND GEON POLYVINYLCHLORIDE, PLASTIC LEAD SEAL-NO-2-JOHN CRANE APCI-MEMO
 990003110 A CELLULUBE-550 FLUOROLUBE SEARS-THREAD-CUTTING-OIL APCI-ANAL-REP IP 7/15/71
 990002890 APCI SET-UP AND OPERATING INSTRUCTIONS FOR AIR-PRODUCTS REDI-SET WELDING AND CUTTING CU
 990001400 KEL-F-LF3, VERSILUBE-F-50, SF81(40)-SILICONE, PYRAUL-F-9, DOW-CORNING-4 COMPOUND SILICONE, DOW-CORNING-4X COM
 990002840 ST GAUGE EQUIPMENT FAILURE SHAKOPEE APCI-MEMO-68 06/12/68 2P
 990004210 PLUSION AND TANKER FIRE AT SHEEPBRIDGE ALLOY CASTINGS LTD APL-MEMO-64 02/75/64 16P
 990004060 APL PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 150PSIG (CS0.1.5) APL-ENGR-STD-LS.31/1
 990004080 APL PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 500PSIG (CS05.0) APL-ENGR-STD-LS.31.3
 990004090 APL PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 720PSIG (CS07.2) APL-ENGR-STD-LS.31.4
 990004070 APL PIPING SELECTION SHEET-CARBON STEEL-WARM OXYGEN SERVICE 275PSIG (CS02.7) APL-ENGR-STD-LS.31/2
 990003370 ELMURE-6. APL SHELL AND TUBE-TYPE-COOLERS FOR OXYGEN SERVICE APL-ENGR-SPEC-E.05 13P 6/1/71
 990001690 FLOURINATED SILICON-OILS, APL SHELL POLYURETHANE FOAM (EPON-FDAM-H-60) APCI-MAR-87-0-8820 IP 8/61
 990001400 HAVLINE-HD-HYDROCARBON, APL SHELL-DESIGN APCI-DES-ENG-STD-510.2 4P 2/65
 990000200 APCI PRESSURE-VESSELS, SHERLOCK-LEAK DETECTOR-WITH-15-PERCENT-METHANOL, SODIUM-NITRITE-SOLUTION INHIBITOR
 990001890 OCK-LEAK-DETECTOR-TYPE-0G, SHERLOCK-LEAK DETECTOR-TYPE-0G, SHERLOCK-LEAK DETECTOR-WITH-15-PERCENT-METHANOL, SO
 990001890 THETIC-CURK, MASKING-TAPE, SHERWIN-WILLIAMS-E414, SUPERFLAKE-1822, SUPERDOK-GRAPHITE-CO, CALQUARTZ-SODIUM SIL
 990002250 URAL- PERSONNEL PROTECTIVE SHIELDS FOR OXYGEN SYSTEMS APCI-DES-ENG-STD-546.1 5P 1/15/71
 990003280 APCI PERSONNEL-PROTECTIVE SHIELDS FOR OXYGEN SYSTEMS APCI-DES-ENG-STD-546.1 5P 1/15/71
 990003020 8/71 TO DISCUSS SAFETY OF SHIPBOARD OX-PLANTS 2P 9/13/71
 990005730 ING, EXCESSIVE VIBRATIONS, SHOCK (THERMAL AND PRESSURE), LINE-SURGES APCI-III-F3B-1 IP 2/18/72
 990003210 APCI WEAR SAFETY SHOES APCI-DES-ENG-STD-510.2 4P 2/65
 990005420 RE INTEGRITY OF INSULATION SHOP FABRICATED OX STORAGE TANKS APCI-III-F3B-1 IP 2/18/72
 990005200 S, AND SURFACE TREATMENTS- SHERIDAN-GRAPHITE IRON CONTINENTAL-STANDARD-GGG-38 APCI-IA6A-34 IP 2/21/72
 990001890 PHITE-CO, CALQUARTZ-SODIUM SILICATE, 3M-DC1252-MARKER-PUTTY, DURABLE-MANUFACTURING COMPANY-GASKET MATERIAL, JU
 990003060 PCI OXYGEN INDEX RATING SILICONE-O-RING (1/8-INCH DIA) APCI-IWU-NU-XD-0128 APCI-ANAL-REP-71-399 IP
 990004660 RS, AND ADHESIVES- RTV-60, SILICONE-RUBBER COMPOUND WITH SS-6004-SILICONE-PRIMER GE THERMOLITE-12-CURING-CATAL
 990001400 N COMPATIBILITY TESTS WITH SILICONE-RUBBER GASKET COMPOUND- RTV-60-NP-134372-M235 APCI-R+D-NOTEBOOK-111 PL4
 99000630 09, DOW-CORNING-4 COMPOUND SILICONE, DOW-CORNING-REF-1-0069, SILICON-OILS DOW-CORNING-REF-1-0069, MORSE GREASE,
 99000630 09, AND EXPLOSION TESTING- SILICON-OILS DOW-CORNING-REF-1-0069, SILICON-OILS DOW-CORNING-REF-1-0069, INDOPOL-POLY
 99000050 ILS DOW-CORNING-REF-1-0069, SILICON-OILS DOW-CORNING-REF-1-0069, INDOPOL-POLYBUTENE-OIL AMOCO-L-10, INDOPOL-POLY
 99000060 N, DOW-CORNING FLUORINATED SILVER APCI-IA6A-35 IP 2/21/72
 990003210 S, AND SURFACE TREATMENTS- SINDANYO CS-51-ASBESTOS AND CEMENT BOARDS, NATURAL-UNTREATED-FINISH TURNERS ASBE
 990004840 PCI GASKETS AND PACKINGS- SMIFF TESTING CYLINDERS HAS ITS HAZARDS APCI-DES-ENG-STD-531.10.2 2P 12/5/61
 99000560 MOYER, W.W. APCI CAUTION- SKIFF THESE CYLINDERS BEFORE REFILLING APCI-DES-ENG-STD-531.10.2 2P 12/5/61
 99000100 SCHMOYER, W.W. APCI SNUBBER APCI-DES-ENG-STD-531.10.2 2P 12/5/61
 990002820 0 EXISTING PRESSURE-GAUGES SNUBBER APCI-DES-ENG-STD-531.10.2 2P 12/5/61
 990001890 -WITH-15-PERCENT-METHANOL, SODIUM-NITRITE-SOLUTION INHIBITOR CRYOGENIC ENGINEERING CONFERENCE PROCEEDINGS

S AND THREADING COMPOUNDS- SODIUM-SILICATE AND CHINA-CLAY-PASTE APCI-IA2A-12 IP 2/21/72
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B211-2024-T4 APCI-IA6A-07 2P 2/2
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B210-6061-T6 APCI-IA6A-10 2P 2/2
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- ALUMINUM B361-WP6061-T6 APCI-IA6A-13 2P 2/21/7
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- YARSEL PITTSBURGH CHEMICAL CO APCI-IA6A-01 1P
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- ALUMINUM, ASTM-B-210-3003 APCI-IA6A-08 2P 2/21
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- COPPER-TUBE ASTM-875 APCI-IA6A-05 1P 2/21/72
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- COPPER-PIPE ASTM-B42 APCI-IA6A-04 1P 2/21/72
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B247-6061-T6 APCI-IA6A-12 2P 2/2
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- PLASITE-ND-7122H WISCONSIN PROTECTIVE COATING C
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B209-5083-0 APCI-IA6A-09 2P 2/21
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- CARBON STEEL (OXYGEN SERVICE) APCI-IA6A-14 3P
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- SEALFAS-MASTIC-31-97 BENJAMIN FOSTER CO APCI-I
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B241-6061-T6 APCI-IA6A-11 2P 2/2
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- RED-BRASS-PIPE ASTM-843 APCI-IA6A-06 1P 2/21/7
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- CARBON STEEL- NON-OXYGEN SERVICE WITH POSSIBLE EX
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- BRASS-SHEET OR PLATE ASTM-B36 APCI-IA6A-28 2P
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- BERYLLIUM COPPER APCI-IA6A-25 2P 2/21/72
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A320-B8304 APCI-IA6A-18 2P
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- MUNTZ-METAL 60-40-TYPE COMPOSITION CU-58 1-PER
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A312-TP304 APCI-IA6A-15 2P
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A182-F-304 AND ASTM-A182-F-31
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- STAINLESS STEEL-TYPE-304 UNIDENTIFIED AS TO ASTM-
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A351-GR-CF8 APCI-IA6A-30 2
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A194-81321 APCI-IA6A-19 2P
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A403-WP304 AND A403-WP304L
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A269-304 APCI-IA6A-26 2P
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- COPPER-SILICON ASTM-B98GRB APCI-IA6A-23 2P 2/2
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- ALPHA BRASS-TYPE TCl-100 OR DTD-5019 TUNGUNG CO L
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- SPHEROIDAL-GRAPHITE IRON CONTINENTAL-STANDARD-GGG-
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- STAINLESS STEEL 9-PERCENT NICKEL ASTM-A353GB AP
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- MONEL ASTM-B164 APCI-IA6A-29 2P 2/21/72
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A240-304 APCI-IA6A-16 2P
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- SILVER APCI-IA6A-35 1P 2/21/72
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- BRUNZE ASTM-B61 OR B62 APCI-IA6A-27 2P 2/21/7
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- FREE-MACHING BRASS APCI-IA6A-24 2P 2/21/72
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- STAINLESS STEELS-TYPE-416-CADMNIUM-PLATEU APCI-IA
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- NOVUNOX STAINLESS STEEL ALLOY TO DIN GERMAN NATI
 APCI METALS, ALLOYS, AND SURFACE TREATMENTS- COPPER-TUBE ASTM-B98 APCI-IA6A-32 1P 2/21/72
 ITANIUM, TITANIUM-DIOXIDE, SOLNUS-500, HYDROCARBON-OIL, TITANIUM-TETRACHLORIDE APCI-MAK-87-0-8822 3P 8/63
 ONT-NEW/JOHNSONVILLE-PLANT SMITH, H. APCI
 GILLOTT, E. APL
 LANT, AND PLANT EQUIPMENT SOLVENT WASHOUT-FREQUENCIES APCI-PUM-SEC-5.07 3P 7/15/70
 APCI PLANT SOLVENT WASHOUT-GENERAL APCI-PUM-SEC-1.05 12P 2/20/67
 APCI CHEMICALS, SOLVENTS, AND MISC CARBON-TETRACHLORIDE APCI-IA7A-04 1P 2/21/72
 APCI CHEMICALS, SOLVENTS, AND MISC- CHLOROFORM APCI-IA7A-03 1P 2/21/72
 APCI CHEMICALS, SOLVENTS, AND MISC- 1,1 DICHLOROTHANE APCI-IA7A-01 1P 2/21/72
 APCI CHEMICALS, SOLVENTS, AND MISC- 1,1,1 TRICHLOROETHANE APCI-IA7A-02 1P 2/21/72
 APCI CHEMICALS, SOLVENTS, AND MISC- METHYLENE-CHLORIDE APCI-IA7A-06 1P 2/21/72
 APCI CHEMICALS, SOLVENTS, AND MISC- TRICHLOROETHYLENE APCI-IA7A-05 1P 2/21/72
 COMBUSTION IN OXYGEN AND SUXHLET ETHER-EXTRACTION GARLOCK-900, KM-226, KM-240 APCI-ANAL-REP-70-013,70-014,
 N COMBUSTION IN OXYGEN AND SUXHLET ETHER-EXTRACTION MELRATH GARLOCK-900 APCI-ANAL-REP-70-026 APCI-IND-NO-E
 TANDARD PRESSURE BUMPS AND SPARK-IGNITION, DOWN-CURNING FLOURINATED SILICON-OILS, SHELL POLYURETHANE FOAM (EPON

OS, AND EXPLOSION TESTING- SPARK-IGNITION, STANDARD BOMB TEST, LEU-PLATE-251, PIPE-DOPE APCI-MAR-87-0-8820
 KRILL, W.R. APCI STANDARD SPECIFICATION FOR A FIELD-FABRICATED CRYOGENIC LIQUID STORAGE-TANK (FLAT-BOTTOM)
 990003410 JERHKE, G.A. APCI GENERAL SPECIFICATION FOR CENTRIFUGAL COMPRESSORS APCI-550-SD-16A 37P 4/15/65
 990003560 GEHRKE, G.R. APCI GENERAL SPECIFICATION FOR CLEANING FOR OXYGEN SERVICE APCI-550-SD-27A 5P 12/10/59
 990003650 PEGRAM, J.W. APL SPECIFICATION FOR OXYGEN SERVICE VESSEL FABRICATION APL-ENGR-SPEC-C.03 7P 7/26
 990003670 PEGRAM, J.W. APL SPECIFICATION FOR OXYGEN SERVICE PRESSURE-VESSEL FABRICATION APL-ENGR-SPEC-C.04
 990003370 STULZ, J.L. APCI GENERAL SPECIFICATION FOR RECIPROCATING COMPRESSORS APCI-550-SD-01A 37P 3/9/64
 990003420 KRILL, W.R. APCI JOB SPECIFICATION 310000 GALLON CAPACITY LOX/LIN STORAGE TANK APCI-JOB SPECIFICAT
 990003360 APCI CONSTRUCTION GENERAL CONSTRUCTION AND EQUIPMENT ERECTION OXYGEN COMPRESSION SY
 990000880 APCI REQUIREMENTS FOR IPD SPECIFIED PAINT SYSTEMS APCI-QUAL-CONT-LAYOUT-120F 3P 7/1/71
 990005500 APCI OPERATIONAL-HAZARDS- SPILLS AND LEAKAGE APCI-IID-1 2P 9/3/71
 990005540 APCI OPERATIONAL-HAZARDS- SPILLS AND LEAKAGE DETECTION- QUANTITY AND RESPONSE TIME LIMITS APCI-IID4-1 1P
 990005510 APCI OPERATIONAL-HAZARDS- SPILLS AND LEAKAGE DRAINAGE AND ULTIMATE DISPOSAL ARRANGEMENTS APCI-IID1-1 2P
 990005530 APCI OPERATIONAL-HAZARDS- SPILLS AND LEAKAGE ENVIRONMENTAL WARNINGS AND ESCAPE SYSTEMS APCI-IID3-1 1P 8
 990005520 APCI OPERATIONAL-HAZARDS- SPILLS AND LEAKAGE SEPARATION OF INCOMPATIBLE MATERIALS AND IGNITION SOURCES IN DIS
 990000710 N-PRESSURE-GAUGE TWI WOOL, SPINTEX-309, MOLYKOTE-TYPE-2 AND TYPE-X-15 APCI-MAR-87-0-8822 1P 3/63
 990001850 TY VALVE WITH CARBON STEEL SPRING APCI-IWO-NU-10-7071 APCI-PROJECT-NU-00-5-3246-51.12.50 APCI-TM-079 3P
 990001350 UNIVERSAL-JOINTING COMPOUND SO-32 AND VITON A APCI-IWO-NU-81-0095 1P 4/27/66
 990004660 ILCONE-RUBBER COMPOUND WITH SS-4004-SILICONE-PRIMER GE THERMOLITE-12-CURING-CATALYST APCI-IA4A-01 1P 2/21/7
 990003920 OSTAR-GB114 LUX-PUMP ON AN SSPC LOX-TANKER APL-SAFETY-DEPT-REP-32 9P 7/10/70
 990003860 OXYGEN COMPRESSOR FIRE AT SSPC ROGNAC PLANT 3/27/71 APL-SAFETY-BULL-107 3P 4/14/71
 990003260 KITSON, F.K. APCI STAFFING AND CHECK-IN SYSTEMS FOR OPERATING-PLANTS APCI-MEMO-68 06/25/68 2P
 990005170 S, AND SURFACE TREATMENTS- STAINLESS 9-PERCENT NICKEL STEEL ASTM-A353GB APCI-IA6A-31 2P 2/21/72
 990004020 OF 9% NICKEL AND HI-PROOF STAINLESS STEEL-TANKS FOR OXYGEN SERVICE APL-QCP-413 REV.0 1P
 990005070 S, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A182-F-304 AND ASTM-A182-F-316 APCI-IA6A-21 2P 2/21/72
 990005050 S, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A194-8T321 APCI-IA6A-19 2P 2/21/72
 990005020 S, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A240-304 APCI-IA6A-16 2P 2/21/72
 990005120 S, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A269-304 APCI-IA6A-26 2P 2/21/72
 990005010 S, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A312-TP304 APCI-IA6A-15 2P 2/21/72
 990005040 S, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A320-B8304 APCI-IA6A-18 2P 2/21/72
 990005160 S, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A351-GR-CF8 APCI-IA6A-30 2P 2/21/72
 990005030 S, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A403-WP304 AND A403-WP304L APCI-IA6A-17 2P 2/21/72
 990005220 US-FACE TREATMENTS- NOVONOX STAINLESS STEEL ALLOY TO DIN GERMAN NATIONAL STANDARDS COMPOSITION 5-PERCENT-C
 990001820 20F TG 150F 150-PSIG-MAX STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.40.1 3P 9/69
 990001790 D BELOW 3000-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.6 3P 1/64
 990001780 D BELOW 1715-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.5 3P 1/64
 990001600 D BELOW 3600-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.8 3P 1/64
 990001760 ND BELOW 615-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.3 4P 11/67
 990001740 - PLAIN-AND-THREADED-ENDS- STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.1 7P 5/62
 990001610 ND BELOW 720-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.15 4P 11/67
 990001750 D BELOW 275-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.2 4P 11/67
 990001770 D BELOW 1235-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.4 3P 1/64
 990003080 S, AND SURFACE TREATMENTS- STAINLESS STEEL-TYPE-304 UNIDENTIFIED AS TO ASTM-SPEC APCI-IA6A-22 2P 2/21/72
 990004880 I IGNITION-LIMITS OF SOME STAINLESS STEELS IN AN OXYGEN-ATMOSPHERE APCI-PROJECT-NU-00-7-3480-51.00 APCI-
 990005060 S, AND SURFACE TREATMENTS- STAINLESS STEELS-TYPE-416-CADIUM-PLATED APCI-IA6A-20 1P 2/21/72
 990004280 IGN-JOINTS AND ALUMINUM TO STAINLESS-STEEL APCI-DES-ENG-STD-579.15 2P 9/66
 990001020 AND FABRICATIONS, CLEANING OF STAINLESS-STEEL AND COPPER-PIPE FITTINGS PARTS AND FABRICATIONS DESCRIPTION OF CL
 990000340 APCI PIPE-PIPING- STAINLESS-STEEL SURFACES EXPOSED TO CASEOUS OXYGEN APL-SAFETY-DEPT-INFO-SHEET-
 990000580 SES, SUPPORTED BY BRAIDED STAINLESS-STEEL VALVES AND MATERIAL REQUIREMENTS APCI-DES-ENG-STD-579.3.1 2P 5/
 990000610 N TESTING- SPARK-IGNITION, STANDARD BOMB TEST, LEU-PLATE-251, PIPE-DOPE APCI-MAR-87-0-8820 1
 990002420 FIRE PREVENTION ASSUC STANDARD FOR THE INSTALLATION AND OPERATION OF OXYGEN-FUEL GAS SYSTEMS FOR WELDIN
 990006090 T.E. APCI DEVELOPMENT OF STANDARD IGNITION TEST APCI-PROJECT-NU-87-0-8820/1 8P 11/17/61
 990006130 T.E. APCI DEVELOPMENT OF STANDARD IGNITION TEST METHYLENE-CHLORIDE- DICHLOROETHANE- TRICHLOROETHANE- TRICHLOR

9900C0650 DS, AND EXPLOSION TESTING- STANDARD IGNITION TEST METHOD, APL PIPING-RESIDUE, METHYLENE-CHLORIDE APCI-MAR-87
 9900003390 STANDARD PICTORIAL SURFACE PREPARATION STANDARDS FOR PAINTING STEEL SURFACES AS APCI-MAR-87
 9900006600 DS, AND EXPLOSION TESTING- STANDARD PRESSURE BOMBS AND SPARK-IGNITION, DOW-CORNING FLUORINATED SILICON-OILS, S
 9900G3410 KRILL, W.R. APCI STANDARD SPECIFICATION FOR A FIELD-FABRICATED CRYOGENIC LIQUID STORAGE-TANK (FLAT-
 L-DESIGN-BASIS AND GENERAL STANDARDS APCI-DES-ENG-STD-510.1 6P 8/62
 990000180 E TRANSPORTATION- LIST OF STANDARDS APCI-IIF2-1 2P 2/18/72
 9900003990 URE FOR DECONTAMINATION OF STATIC-TANK AND ROAD-VEHICLE-ASSEMBLIES FOR OXYGEN SERVICE APL-QCP-110 REV.0 2
 990004010 G OF ALUMINUM TANKERS AND STATIC-TANKS FOR OXYGEN SERVICE APL-QCP-112 REV.0 1P
 990004020 KEL AND HI-PROOF STAINLESS STATIC-TANKS FOR OXYGEN SERVICE APL-QCP-013 REV.0 1P
 990001730 F 3600-PSIG-MAX-OWG CARBON STEEL APCI-DES-ENG-STD-578.10.6 3P 6/62
 990005070 FACE TREATMENTS- STAINLESS STEEL ASTM-A182-F-304 AND ASTM-A182-F-316 APCI-IA6A-21 2P 2/21/72
 990005050 FACE TREATMENTS- STAINLESS STEEL ASTM-A240-304 APCI-IA6A-19 2P 2/21/72
 990005120 FACE TREATMENTS- STAINLESS STEEL ASTM-A269-304 APCI-IA6A-16 2P 2/21/72
 990005010 FACE TREATMENTS- STAINLESS STEEL ASTM-A312-TP304 APCI-IA6A-15 2P 2/21/72
 990005040 FACE TREATMENTS- STAINLESS STEEL ASTM-A320-B8304 APCI-IA6A-18 2P 2/21/72
 990005160 FACE TREATMENTS- STAINLESS STEEL ASTM-A351-GR-CF8 APCI-IA6A-30 2P 2/21/72
 990005170 FACE TREATMENTS- STAINLESS STEEL ASTM-A353GB APCI-IA6A-31 2P 2/21/72
 990005030 FACE TREATMENTS- STAINLESS STEEL ASTM-A403-WP304 AND A403-WP304L APCI-IA6A-17 2P 2/21/72
 990001870 IGNITION-LIMITS OF CARBON STEEL IN OXYGEN-NITROGEN-ATMOSPHERES APCI-IWO-NO-LB-0043 APCI-TM-112 6P 5/8/6
 9900G5220 ATMENTS- NOVONOX STAINLESS STEEL ALLOY TO DIN GERMAN NATIONAL STANDARDS COMPOSITION 5-PERCENT-CR 17-PERC
 9900C3390 ON STANDARDS FOR PAINTING STEEL SURFACES ASTM-D2200-67 2P 1967
 990005000 SURFACE TREATMENTS- CARBON STEEL (OXYGEN SERVICE) APCI-IA6A-14 3P 2/21/72
 990001020 APCI CLEANING OF CARBON STEEL PIPE AND FITTINGS, CLEANING ALUMINUM-PIPE FITTINGS PARTS AND FABRICATIONS,
 990001850 KEHAT, E. APCI BURNING OF STEEL PIPES IN A FLOWING OXYGEN STREAM APCI-IP-10-04/17/61 3P PLUS 7P ATTA
 990001850 H SAFETY VALVE WITH CARBON STEEL SPRING APCI-IWO-NG-10-7071 APCI-PROJECT-NO-00-5-3246-5L.12.50 APCI-TM-0
 990005190 SURFACE TREATMENTS- CARBON STEEL- NON-OXYGEN SERVICE WITH POSSIBLE EXPOSURE TO OXYGEN APCI-IA6A-33 3P 2/
 990001820 OF 150-PSIG-MAX STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.40.1 3P 9/69
 990001720 D-THREADED-ENDS- STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.1 7P 5/62
 990001720 2000-PSIG-MAX-OWG CARBON STEEL-PIPE APCI-DES-ENG-STD-578.10.5 4P 1/64
 990001700 F 720-PSIG-MAX-OWG CARBON STEEL-PIPE APCI-DES-ENG-STD-578.10.3 3P 6/62
 990001760 615-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.3 4P 11/67
 990001770 235-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.4 3P 1/64
 990001660 -AND-THREADED-ENDS- CARBON STEEL-PIPE APCI-DES-ENG-STD-578.10.1 6P 10/65
 990001810 1440-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.15 4P 11/67
 990001750 275-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.10.4 4P 1/64
 990001780 715-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.2 4P 11/67
 990001790 000-PSIG-MAX-OWG STAINLESS STEEL-PIPE APCI-DES-ENG-STD-578.30.5 3P 1/64
 990001840 F 150-PSIG-MAX-OWG CARBON STEEL-PIPE APCI-DES-ENG-STD-578.10.19 2P 6/62
 990000590 ING- UCON-TYPE LUBRICANTS, STEEL-PIPES APCI-MAR-87-0-8820 1P 4/61
 990005080 FACE TREATMENTS- STAINLESS STEEL-TYPE-304 UNIDENTIFIED AS TO ASTM-SPEC APCI-IA6A-22 2P 2/21/72
 990004060 ING SELECTION SHEET-CARBON OXYGEN SERVICE 150PSIG (CS.1.5) APL-ENGR-STD-LS.31/1 7P 6/12/70
 990004090 ING SELECTION SHEET-CARBON OXYGEN SERVICE 720PSIG (CS.07.2) APL-ENGR-STD-LS.31.4 6P 6/12/70
 990004080 ING SELECTION SHEET-CARBON OXYGEN SERVICE 500PSIG (CS.5.0) APL-ENGR-STD-LS.31.3 6P 6/12/70
 990004070 ING SELECTION SHEET-CARBON OXYGEN SERVICE 275PSIG (CS.2.7) APL-ENGR-STD-LS.31/2 6P 1/29/70
 990001890 ASBESTOS, ALUMINUM-CHIPS, MAGNESIUM-CHIPS, MAGNESIUM-SHEET, DYE-PENETRANTS, MAGNOLIO-PASTEIO IN
 990001860 N-LIMITS OF SOME STAINLESS STEELS IN AN OXYGEN-ATMOSPHERE APCI-PROJECT-NO-00-7-3480-51.00 APCI-TM-114 5P
 9900G0030 F.K. APCI APPROVED ALLOY STEELS IN CRYOGENIC SERVICE APCI-SAFETY-GRAM-NO-10-REV-1 1P 10/25/63
 990005050 FACE TREATMENTS- STAINLESS STEELS-TYPE-416-CADMIUM-PLATED APCI-IA6A-20 1P 2/21/72
 990003930 STAR LUX-PUMP EXPLOSION AT STUKE PLANT 87/770 APL-SAFETY-DEPT-REP-34 14P 8/24/70
 990004140 UGENIC TANKERS BY PUMP AT STUKE-ON-TRENT APL-160-ENGR-MAN-50-03 3P 5/27/71

990000160 RE-VESSELS- GASEOUS OXYGEN STORAGE CYLINDER APCI-DES-ENG-STD-515.1.3 3P 10/17/60 APCI-JOB SPECIFICATION FOR JOB-NO-00-2-2775 APCI-NG-71-2775-16.
 990003420 0 GALLON CAPACITY LOX/LIN STORAGE TANK APCI-JOB SPECIFICATION FOR JOB-NO-00-2-2775 APCI-NG-71-2775-16.
 990003430 ARGE, WELDED, LOW-PRESSURE STORAGE TANKS API STANDARD-620 2/7/70
 990000890 MASTER, H.O.H. APCI TANK CLEANING APCI-MEMO-63 01/24/63 IP
 990000900 Y, A.L. APCI CLEANING LOX STORAGE TANK-NO-6 SANTA/SUSANA APCI-MEMO-64 03/11/64 IP PLUS IP ATTACHMENT
 990005580 BRICATED CRYOGENIC LIQUID STORAGE TANKS APCI-IIFI-3 IP 2/3/72
 990005560 SK PRODUCTION TO STORAGE, STORAGE TO TRANSPORT, TRANSPORT TO SYSTEM APCI-IIFI-1 IP
 990005570 XGEN-TRANSFER PRODUCTION, STORAGE TO SYSTEM, STORAGE TO TRANSPORT, TRANSPORT TO SYSTEM LOADING AND UNLOADI
 990003410 ABRICATED CRYOGENIC LIQUID STORAGE-TANK (FLAT-BOTTOM) APCI-99820A 18P 9/15/71
 990000480 APCI PLANT COMPONENTS- STORAGE, CONVERTER-SYSTEM, AND CRYOGENIC-LIQUIDS APCI-SAFETY-STD-607.2.1.1 3P 4
 990000450 APCI PLANT COMPONENTS- STORAGE, VACUUM-SYSTEMS, AND COMPRESSED-GASES APCI-SAFETY-STD-607.2.2.5 3P 4
 990005370 LITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY APCI-182A-1 2P 9/2/71
 990005390 LITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY FABRICATION AND WELDING APCI-182D-1 2P 10/28
 990005360 LITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY APCI-182-1 2P 2/10/72
 990005380 LITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY NOTCH-SENSITIVITY OF MATERIALS APCI-182C-1 IP
 990005400 LITY, COMPATIBILITY CHECK, STRUCTURAL-MATERIALS-COMPATIBILITY MATERIALS AND PARTS SUITABILITY CONTROLS APCI
 990005760 SPECTION WHERE WHY AND HOW STRUCTURE APCI-IIFI-1 IP 9/12/71
 990002010 LATIONSHIP OF THE CHEMICAL STRUCTURE OF CUTTING GILS TO THEIR OXYGEN-COMPATIBILITY AICHE-CEP-TECH-MANUAL SA
 990000660 N-F, FOAM-TYPE INSULATIONS STYROFOAM AND POLYURETHANE-FOAM-INSULATION, RAYBESTOS-MANHATTAN-PACKING, AND IMPRE
 990000680 QN-H-80, POLYCEL-440R, AND STYROFOAM, LUBRICANTS, MOLY-SPRAY-KOTE, AND ORI-LUBE APCI-MAR-87-0-8821 IP 4/62
 990000920 APCI WASHUOT ANALYSIS OF SUN-OIL COMPANY_S LOX-TANK VAPORIZER APCI-MEMO-64 04/9/64 IP PLUS IP ATTACHMEN
 990001890 R, SHERWIN-WILLIAMS-E41A4, SUPERFLAKE-1822, SUPERIOR-GRAPHITE-CO, CALQUARTZ-SODIUM SILICATE, 3M-DC1252-MARKER-
 990001890 MS-E41A4, SUPERFLAKE-1822, SUPERIOR-GRAPHITE-CO, CALQUARTZ-SODIUM SILICATE, 3M-DC1252-MARKER-PUTTY, OURABLE-MA
 990003680 APL BRAZED COPE EXTENDED SURFACE PREPARATION STANDARDS FOR PAINTING STEEL SURFACES ASTM-D2200-67 2P 19
 990003390 ASTM STANDARD PICTERIAL SURFACE PREPARATION STANDARDS FOR PAINTING STEEL SURFACES ASTM-D2200-67 2P 19
 990004870 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- TARGET PITTSBURGH CHEMICAL CO APCI-IA6A-01 IP 2/21/72
 990005240 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALPHA BRASS-TYPE TCL-100 OR DTD-5019 TUNGUM CO LTD/JUK COMPOSI
 990004930 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B211-2024-T4 APCI-IA6A-07 2P 2/21/72
 990004990 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM B361-WP6061-16 APCI-IA6A-13 2P 2/21/72
 990004970 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B241-6061-T6 APCI-IA6A-11 2P 2/21/72
 990004950 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B209-5083-0 APCI-IA6A-09 2P 2/21/72
 990004980 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B247-6061-T6 APCI-IA6A-12 2P 2/21/72
 990004940 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM, ASTM-B-210-3003 APCI-IA6A-08 2P 2/21/72
 990004960 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- ALUMINUM ASTM-B210-6061-T6 APCI-IA6A-10 2P 2/21/72
 990005110 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- BERYLLIUM COPPER APCI-IA6A-25 2P 2/21/72
 990005140 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- BRASS-SHEET OR PLATE ASTM-B36 APCI-IA6A-28 2P 2/21/72
 990005130 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- BRUNZE ASTM-B61 OR B62 APCI-IA6A-27 2P 2/21/72
 990005000 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- CARBON STEEL (OXYGEN SERVICE) APCI-IA6A-14 3P 2/21/72
 990005190 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- CARBON STEEL- NON-OXYGEN SERVICE WITH POSSIBLE EXPOSURE TO OX
 990004910 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- COPPER-TUBE ASTM-B75 APCI-IA6A-05 IP 2/21/72
 990004900 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- COPPER-PIPE ASTM-B42 APCI-IA6A-04 IP 2/21/72
 990005090 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- COPPER-SILICON ASTM-B986K8 APCI-IA6A-23 2P 2/21/72
 990005100 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- FREE-MACHING BRASS APCI-IA6A-24 2P 2/21/72
 990005150 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- MONEL ASTM-B164 APCI-IA6A-29 2P 2/21/72
 990005230 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- MUNTZ-METAL 60-40-TYPE COMPOSITION CU-58 1-PERCENT ZN38.5-5-4
 990005220 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- NOVNUX STAINLESS STEEL ALLOY TO DIN GERMAN NATIONAL STANDAR
 990004890 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- PLASTE-NO-7122H WISCONSIN PROTECTIVE COATING CO APCI-IA6A
 990004920 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- RED-BKASS-PIPE ASTM-B43 APCI-IA6A-06 IP 2/21/72
 990004880 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- SEALFAS-MASTIC-31-97 BENJAMIN FOSTER CO APCI-IA6A-02 IP 2
 990005210 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- SHPERIODAL-GRAPHITE IRON CONTINENTAL-STANDARD-666-38 APCI-IA6
 990005010 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A312-TP304 APCI-IA6A-15 2P 2/21/72
 990005020 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A240-304 APCI-IA6A-16 2P 2/21/72
 990005170 TALS, ALLOYS, SOLDERS, AND SURFACE TREATMENTS- STAINLESS 9-PERCENT NICKEL STEEL ASTM-A353GR APCI-IA6A-31 2

990005060 TALS, ALLOYS, SOLDER, AND SURFACE TREATMENTS- STAINLESS STEEL-TYPE-304 UNIDENTIFIED AS TO ASTM-SPEC APCI-I
 990005070 TALS, ALLOYS, SOLDER, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A403-WP304 AND A403-WP304L APCI-IA6A-17
 990005080 TALS, ALLOYS, SOLDER, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A182-F-304 AND ASTM-A182-F-316 APCI-IA6A
 990005090 TALS, ALLOYS, SOLDER, AND SURFACE TREATMENTS- STAINLESS STEELS-TYPE-416-CADMIUM-PLATED APCI-IA6A-20 IP 2/
 990005100 TALS, ALLOYS, SOLDER, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A321-GR-CF8 APCI-IA6A-30 2P 2/21/72
 990005110 TALS, ALLOYS, SOLDER, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A269-304 APCI-IA6A-26 2P 2/21/72
 990005120 TALS, ALLOYS, SOLDER, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A320-B8304 APCI-IA6A-18 2P 2/21/72
 990005130 TALS, ALLOYS, SOLDER, AND SURFACE TREATMENTS- STAINLESS STEEL ASTM-A154-8T321 APCI-IA6A-19 2P 2/21/72
 990005140 TALS, ALLOYS, SOLDER, AND SURFACE TREATMENTS- COPPER-TUBE ASTM-B88 APCI-IA6A-32 IP 2/21/72
 990005150 PCI MAINTENANCE PROGRAM- SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW SYSTEM INSTRUMENTATION AND CONTROL
 990005160 PCI MAINTENANCE PROGRAM- SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW GENERAL CONSIDERATIONS OF THE AGING
 990005170 PCI MAINTENANCE PROGRAM- SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW STRUCTURE APCI-IIIA1-1 IP 9/12/71
 990005180 PCI MAINTENANCE PROGRAM- SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW LEAKS APCI-IIIA2-1 IP 9/12/71
 990005190 PCI MAINTENANCE PROGRAM- SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW INSULATION CHECK APCI-IIIA4-1 IP
 990005200 PCI MAINTENANCE PROGRAM- SYSTEM CHECK AND INSPECTION WHERE WHY AND HOW PREVENTIVE MAINTENANCE PROGRAM
 990005210 APCI APCI-IV-1 IP 12/23/71
 990005220 APCI SYSTEM-EMERGENCIES HAZARDS PROTECTION GENERAL PRECAUTIONS APCI-IVE-1 2P 11/8/77
 990005230 APCI SYSTEM-EMERGENCIES HAZARDS PROTECTION APL-BULLETS AND REPORTS ON VARIOUS PROBLE
 990005240 APCI SYSTEM-EMERGENCIES PROTECTION BUILDINGS AND ADJACENT SYSTEMS PROTECTION APCI-I
 990005250 APCI SYSTEM-EMERGENCIES PROTECTION PERSONNEL APCI-IVCI-1 6P 1/13/72
 990005260 APCI SYSTEM-EMERGENCIES SAFETY TRAINING AND AREA PLACARDING APCI-IVA-1 4P 11/5/71
 990005270 APCI SYSTEM-EMERGENCIES WARNING DEVICES APCI-IVB-1 5P 11/12/71
 990005280 - OXYGEN-TRANSFER SYSTEMS- APL OXYGEN-TRANSFER METHODS TYPICAL INSTALLATIONS, AND OPERATIONS DEPART
 990005290 - OXYGEN-TRANSFER SYSTEMS- FIELD FABRICATED CRYOGENIC LIQUID STORAGE TANKS APCI-IIIF1-3 IP 2/3/77
 990005300 UN TU STORAGE, STORAGE TO SYSTEM, STORAGE TO TRANSPORT, TRANSPORT TO SYSTEM APCI-IIIF1-1 IP 12/22/71
 990005310 FER PRODUCTION, STORAGE TO SYSTEM, STORAGE TO TRANSPORT, TRANSPORT TO SYSTEM APCI-IIIF1-1 IP 12/22/71
 990003900 ERSON, I. APL ACCIDENT AT T TURNER LTD PARK/LANE ROYTON OLDHAM LANCASTER 11940 AM 5/2/70 APL-SAFETY-D
 990002020 SAFETY CONTROL PROCEDURE- TAG CUT APCI-POM-SEC-1.03 2P PLUS EXHIBIT-A IP 2/15/67
 990002080 SAFETY CONTROL PROCEDURE- TAG OUT PROCEDURE APCI-SAFETY-STD-6263.3 2P 5/62
 990002700 DS, AND EXPLOSION TESTING- TALCUM-POWDER AS A LUBRICANT, TARGET, PLASITE APCI-MAR-87-0-8821 IP 7/62
 990001890 BUTYL-RUBBER, IRON-OXIDES, TALC, ASBESTOS, ALUMINUM-CHIPS, STEEL-WOOL, MAGNESIUM-CHIPS, MAGNESIUM-SHEET, DYE-P
 990004170 INSTALLATION OF A CRYOGENIC TANK CLEANING APCI-IGD-ENGR-MAN-60-01 6P 5/19/71
 990000890 MASTER, H. APCI STORAGE TANK CLEANING APCI-MEMO-63 01/24/63 IP
 990004120 DURE FOR FILLING CRYOGENIC TANKER BY PUMP AT CARRINGTON APL-IGD-ENGR-MAN-50-01 3P 5/27/71
 990004210 RIFUGAL PUMP EXPLOSION AND TANKER FIRE AT SHEEPBRIDGE ALLOY CASTINGS LTD APL-MEMO-64 02/5/64 16P
 990003890 N EXPLOSION OF LOX-PUMP ON TANKER-400-11 1/7/70 AT JOHN/SUMMERS STEEL WORKS/SHOTTON PUMP-TYPE-GB114-SERIAL -
 990003940 TAR-66.114-PUMP-NO-C.75 ON TANKER-400-11 2/17/71 AT THE CARRINGTON PLANT APL-SAFETY-DEPT-REP-35 7P PLUS
 990003140 E DISCS MANUFACTURED LOX TANKERS BY AMETEK APCI-MEMO-71 06/22/71 IP
 990004130 DURE FOR FILLING CRYOGENIC TANKERS BY PUMP AT BRACKNELL APL-IGD-ENGR-MAN-50-02 3P 5/27/71
 990004140 DURE FOR FILLING CRYOGENIC TANKERS BY PUMP AT STUKE-ON-TRENT APL-IGD-ENGR-MAN-50-03 3P 5/27/71
 990000900 APCI CLEANING LOX STORAGE TANK-NO-6 SANTA/SUSANA APCI-MEMO-64 05/11/64 IP PLUS IP ATTACHMENT
 990001950 SEU GAS ASSUC INSULATED TANK-TRUCK SPECIFICATION CGA-341 FOK COLD LIQUEFIED-GASES CGA-PAMPHLET-341-TENTA
 990005580 CRYOGENIC LIQUID STORAGE TANKS APCI-IIIF1-3 IP 2/3/72
 990000810 MASTER, H. APCI LOX TANKS APCI-MEMO-70 06/26/70 IP
 990000390 INTING- COLD-BOXES THERMAL TANKS PERLITE APCI-DES-ENG-STD-581.1 4P 5/26/61
 990000410 NTING- COLD-BOXES, THERMAL TANKS, GLASS WOOL APCI-DES-ENG-STD-581.3 IP 10/24/60
 990004530 THREADING COMPOUNDS- DAMCO TAPE APCI-IAZA-07 2P 2/21/72
 990004540 HREADING COMPOUNDS- SANDEN TAPE APCI-IAZA-08 2P 2/21/72
 990001150 FROEDERICK, L. APCI TEFLON TAPE PERCENT ETHER EXTRACTABLE CONTAMINANTS AND FLUORESCENCE DAMCO-TEFLON TAPE, SAN
 990001130 OF CRUSSLITE FLUOROCARBON YOUNG, L. APCI TAPE THREE-M-FLUOROCARBON-TAPE, PERMACEL-TAPE APCI-MEMO-63 07/30/63 IP
 990001150 FLUORESCENCE DAMCO-TEFLON TAPE, SANDEN-INDUSTRIAL, CRANE PACKING CO APCI-ANAL-REP-70-369, 70-369 IP 10/7
 990001450 BROPHY, M. APCI TAPE-SEAL THREAD LUBRICANT AND SEALER- TAPE-SEAL FROM FRIESLANG-PLASTIC COMPANY, P
 990004870 AND SURFACE TREATMENTS- TARGET PIPE-COATING THE PLASITE TESTS MANUFACTURED BY PITTSBURGH CHEMICAL CO A
 APCI-IA6A-01 IP 2/21/72

990000700 CUM-POWDER AS A LUBRICANT, TARSET, PLASITE APCI-MAR-87-0-8821 IP 7/62
 990000240 FATMENTS- ALPHA BRASS-TYPE TCL-100 OR DTD-5019 TUNGUM CO LTD/UK COMPOSITION- COPPER-86-PERCENT ALUM-1.20-P
 990000390 LM-SPRAYABLE-A, DKILUBE-1, TEFLON DISPERSION-T-FILM, HYDROCARBON-GREASE, HYDRAULIC-OIL, CHLORINATED-BIPHENYL-A
 990000140 PREGNATED ASBESTOS-PACKING TEFLON COATED ASBESTOS-BLUE APCI-MEMO-60 09/30/60 2P PLUS IP ATTACHMENT
 990000150 FREDERICK, L. APCI TEFLON TAPE PERCENT ETHER EXTRACTABLE CONTAMINANTS AND FLUORESCENCE DAMCO-TEFLON TA
 990000570 KINETICS EXPERIMENTATION- APCI-MAR-87-0-8820 IP 5/60
 990000580 LLEU KINETICS EXPERIMENTS- TEFLON-HOSE, SUPPORTED BY BRAIDED STAINLESS-STEEL-HOUSING, AND RUBBER-HOSES PLAS
 990000480 S AND THREADING COMPOUNDS- TEFLON-TAPE PERMACEL APCI-IA2A-02 2P 2/21/72
 990000480 PCI GASKETS AND PACKINGS- TEFLON, DUPONT APCI-IA5A-10 2P 2/21/72
 9900001890 POLYTETRAFLUOROETHYLENE, TEFLON, POLYTRICHLOROVINYLCHLORIDE, KEL-F, POLYHEXAFLUOROPROPYLENE VITON A VINYLID
 9900002220 LAPIN, A. APCI TELEPHONE CONVERSATION WITH MR WILLIAM MCCORMICK REGARDING REQUIREMENTS FOR VENDO
 990000660 XPLESION TESTING- IGNITION TEST-APPARATUS, FLORUBE-GREASES, EPOXY COMPOUNDS DEVCCN-2-TON AND DEVCCN-F, FUAM-TY
 990000310 PES OF OILS- MOBIL-DTE-105 TEST, LEO-PLATE-251, PIPE-DOPE APCI-MAR-87-0-8820 IP 9/61
 990000390 TIGATION OF VALVE FIRES AT TEXACO-CAPPELLA-AA CELLULUBE-550 FLUOROLUBE SEARS-THREAD-CUTTING-OIL APCI-ANAL-RE
 990000470 PCI GASKETS AND PACKINGS- TFE-GF-GREEN, MELRATH GASKETS CO APCI-IA5A-02 IP 2/21/72
 9900004650 APCI THERMAL AND ELECTRICAL INSULATIONS- NATIONAL-GYPSUM-BLUE NATIONAL-GYPSUM CORP AP
 9900004630 APCI THERMAL AND ELECTRICAL INSULATIONS- PERLITE APCI-IA3A-05 IP 2/21/72
 9900004620 APCI THERMAL AND ELECTRICAL INSULATIONS- TRANSITE, JOHNS-MANVILLE APCI-IA3A-02 IP 2
 9900004640 APCI THERMAL AND ELECTRICAL INSULATIONS- MINERAL-WOOL APCI-IA3A-04 IP 2/21/72
 9900004610 APCI THERMAL AND ELECTRICAL INSULATIONS- MILFOAM MILFOAM CORP APCI-IA3A-06 IP 2/21/
 9900004590 APCI THERMAL AND ELECTRICAL INSULATIONS- GLASS-WOOL APCI-IA3A-03 IP 2/21/72
 990000390 N AND PAINTING- COLD-BOXES THERMAL TANKS PERLITE APCI-DES-ENG-STD-581.1 4P 5/26/61
 990000410 AND PAINTING- COLD-BOXES, GLASS WOOL APCI-DES-ENG-STD-581.3 IP 10/24/60
 9900004660 SS-4004-SILICONE-PRIMER GE THERMOLITE-12-CURING-CATALYST APCI-IA4A-01 IP 2/21/72
 9900003130 TSHAW, D. R. APCI OXY-TITE THREAD COMPOUND APCI IAO-NO-XD-0134 APCI-ANAL-REP-71-336 IP 10/22/71
 990000090 M.W. APCI LUBRICANTS AND THREAD COMPOUNDS FOR OXYGEN-SYSTEMS APCI-ANAL-REP-61-683 APCI-IWO-NG-80-0068 IP
 9900001140 YODER, L. APCI T-FILM THREAD COMPOUNDS, AUTOIGNITION TEST APCI-ANAL-REP-61-683 APCI-IWO-NG-80-0068 IP
 9900001160 R VARIOUS MATERIALS- ABMA THREAD LUBRICANT AND SEALANT, ANDEROL-L-536 RUST-PREVENTIVE LEHIGH CHEMICAL CO-CHE
 9900001150 YODER, L. APCI TAPE-SEAL OVER, M. A. APCI REGULATOR TAPE-SEAL FROM FRIELAND-PLASTIC COMPANY, PERMACEL-TA
 9900001180 PCI PIPING- APPROVED PIPE THREAD SEALANT MOLYBDE-N APCI-MEMO-63 10/4/63 IP
 9900004550 APCI SEALANTS AND THREADING COMPOUNDS- APICI-DES-ENG-STD-570.5.1 IP 11/11/60
 9900004520 APCI SEALANTS AND THREADING COMPOUNDS- CRANE PACKING CG-TAPE APCI-IA2A-09 2P 2/21/72
 9900004530 APCI SEALANTS AND THREADING COMPOUNDS- CROSSLITE-FLUOROCARBON-TAPE APCI-IA2A-06 2P 2/21/72
 9900004510 APCI SEALANTS AND THREADING COMPOUNDS- OAMCU TAPE APCI-IA2A-07 2P 2/21/72
 9900004560 APCI SEALANTS AND THREADING COMPOUNDS- MOLYBDE-N BEL-RAY CO FARMINGDALE/NJ APCI-IA2A-05 IP 2/2
 9900004470 APCI SEALANTS AND THREADING COMPOUNDS- OXOMAT APCI-IA2A-10 IP 2/21/72
 9900004500 APCI SEALANTS AND THREADING COMPOUNDS- PERMATEX-1516 APCI-IA2A-01 IP 2/21/72
 9900004580 APCI SEALANTS AND THREADING COMPOUNDS- PUTTI-ROPE NATIONAL GREENHOUSE CU APCI-IA2A-04 IP 2/21/7
 9900004480 APCI SEALANTS AND THREADING COMPOUNDS- SANDEN TAPE APCI-IA2A-08 2P 2/21/72
 9900004570 APCI SEALANTS AND THREADING COMPOUNDS- SODIUM-SILICATE AND CHINA-CLAY-PASTE APCI-IA2A-12 IP 2/21/
 9900004570 APCI SEALANTS AND THREADING COMPOUNDS- TEFLON-TAPE PERMACEL APCI-IA2A-02 2P 2/21/72
 9900004490 APCI SEALANTS AND THREADING COMPOUNDS- THREE-M FLUOROCARBON-TAPE APCI-IA2A-11 2P 2/21/72
 9900004570 S AND THREADING COMPOUNDS- T-FILM ECO MFRG CU APCI-IA2A-03 IP 2/21/72
 9900004570 S AND THREADING COMPOUNDS- THREE-M FLUOROCARBON-TAPE APCI-IA2A-11 2P 2/21/72
 9900001130 RUSSELLITE FLUOROCARBON TAPE THREE-M-FLUOROCARBON-TAPE, PERMACEL-TAPE APCI-MEMO-63 07/30/63 IP
 990000740 HNSONVILLE-PLANT TITANIUM, TITANIUM-DIOXIDE, SOLNUS-500, HYDROCARBON-OIL, TITANIUM-TETRACHLORIDE APCI-MAR-87
 990000740 LNUS-500, HYDROCARBON-OIL, TITANIUM-TETRACHLORIDE APCI-MAR-87-0-8822 3P 8/63
 9900006750 SONVILLE-PLANT SOLNUS-500, TITANIUM-TETRACHLORIDE APCI-MAR-87-0-8822 2P 9/63
 990000740 QNT-NEW/JHNSONVILLE-PLANT TITANIUM, TITANIUM-DIOXIDE, SOLNUS-500, HYDROCARBON-OIL, TITANIUM-TETRACHLORIDE A
 9900001000 EM6LY OF GAYLEN REGULATORS T-FILM APCI-MEMO-61 11/30/61 IP
 9900001000 APCI IGNITION TESTS OF T-FILM AND PENTON APCI-MEMO-61 11/28/61 2P
 9900004490 S AND THREADING COMPOUNDS- T-FILM ECO MFRG CU APCI-IA2A-03 IP 2/21/72

990001140 YODER, L. APCI T-FILM THREAD COMPOUND, AUTOIGNITION TEST APCI-ANAL-REP-61-663 APCI-IWO-NO-80-0
 990000630 E-OIL AMDCU-H-100, PENTON, T-FILM-THREAD COMPOUND APCI-MAR-87-0-8821 1P 11/61
 990003340 UNNEL-PROTECTIVE-EQUIPMENT TONNAGE AIR-SEPARATION PLANT APCI-SAFETY-STD-627.5.1 4P 6/15/70
 990001030 PECTS OF RECONSTRUCTED ICI TONNAGE OXYGEN PLANT AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS
 990002700 HANDLING OF REGULATORS AND TORCHES APCI-PAPER 17P PLUS 2P ATTACHMENTS 7/65
 990000130 SCHMOYER, W.W. APCI HUMAN TORCHES APCI-SAFETY-GRAM-NO-50C 1P 1/3/66
 990002160 GROWTH-RATES AND FRACTURE TOUGHNESS STUDY OF WELDED ALUMINUM ALLOY-5083 ASME WINTER ANNUAL-MEETING NEW/Y
 990002990 CYLINDER GAS CO OXYGEN TRAILER FIRE AICHE-CEP-TECH-MANUAL SAFETY IN AIR AND AMMONIA PLANTS V-4 PP4
 990003070 UID-CARBONIC-LIQUID-OXYGEN TRAILER- ACCIDENT VICTORY-MEMORIAL-HOSPITAL 5/70 APCI-MEMO-71 06/3/71 17P
 990003700 PERATIONAL-HAZARDS- OXYGEN TRANSFER EQUIPMENT MALFUNCTIONS AND FAILURES COMPRESSURS AND PUMPS APCI-IIF3-4
 990001460 VALLEY-FORGE-GASKET-CO LOX TRANSFER FLUOROGREEN-E-600 APCI-MEMO-70 10/23/70 1P
 990003750 PEGRAM, J.W. APL TRANSFER HOSE FOR CRYOGENIC LIQUIDS APL-ENGR-SPEC-L.11 3P 7/7/69
 990002660 MASTER, H.H. APCI LOX TRANSFER PUMP SCREENS APCI-MEMO-69 01/24/69 2P PLUS 3P ATTACHMENTS
 990002650 MASTER, H.H. APCI LOX TRANSFER PUMPS APCI-MEMO-68 12/30/68 2P PLUS 2P ATTACHMENTS
 990001340 ER, E.G. APCI BEHAVIOR OF TRANSITE UNDER COMPRESSIVE-LOADS AT AMBIENT AND LIQUID-NITROGEN TEMPERATURES A
 990004600 D ELECTRICAL INSULATIONS- TRANSITE, JOHNS-MANVILLE APCI-IA3A-02 1P 2/21/72
 990000370 APCI PIPING- TRANSITION-JOINTS AND ALUMINUM TO STAINLESS-STEEL APCI-DES-ENG-STD-579.15 2P 9/
 990001890 IDE, CIS-DICHLOROETHYLENE, TRANS-DICHLOROETHYLENE, VINYLIDENA-CHLORIDE, TRICHLOROETHYLENE, ETHYL-ALCOHOL, METH
 990003450 S USED FOR GASEOUS OXYGEN TRANSMISSION AND DISTRIBUTION CGA-DOCKET 70-11 CGA-THIRD DRAFT 23P 3/22/72
 990004050 BON-STEEL GASEOUS OXYGEN TRANSMISSION-LINES APL-ENGR-STD-LS.30/2 3P 1/12/70
 990005560 M, STORAGE TO TRANSPORT, TRANSPORT TO SYSTEM APCI-IIF1-1 1P 12/22/71
 990005570 M, STORAGE TO TRANSPORT, TRANSPORT TO SYSTEM LOADING AND UNLOADING PROCEDURES FOR LIQUID OXYGEN TRANSFER
 990003560 FICE OF PIPELINE SAFETY TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STAND
 990003540 FICE OF PIPELINE SAFETY TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STAND
 990003530 FICE OF PIPELINE SAFETY TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STAND
 990003570 FICE OF PIPELINE SAFETY TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STAND
 990003510 FICE OF PIPELINE SAFETY TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STAND
 990003520 FICE OF PIPELINE SAFETY TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE- MINIMUM FEDERAL SAFETY-STAND
 990005640 LROAD BARGE AND PIPELINE TRANSPORTATION ROAD, RAILROAD, BARGE AND PIPELINE TRANSPORTATION OXYGEN-DISPERSAL
 990005820 NG PROCEDURES FOR FILTERS, TRAPS, AND INSTRUMENTS APCI-IIB-1 2P 11/1/71
 990001360 ROETHANE- TRICHLOROETHANE- TRICHLOROETHYLENE- CARBON-TETRACHLORIDE- CHLOROFORM APCI-PROJECT-NO-87-8-8821 AP
 990005260 OLVENTS, AND MISC- 1,1,1 TRICHLOROETHANE APCI-IA7A-02 1P 2/21/72
 990001890 BROETHANE, DICHLOROETHANE, TRICHLOROETHANE POLYMERS, POLYSULFIDE-SEALER, BUNA-N, NEOPRENE, EPOXY-ADHESIVE, PHE
 990001360 -CHLORIDE- DICHLOROETHANE- TRICHLOROETHANE- TRICHLOROETHYLENE- CARBON-TETRACHLORIDE- CHLOROFORM APCI-PROJECT-
 990005290 CALS, SOLVENTS, AND MISC- TRICHLOROETHYLENE APCI-IA7A-05 1P 2/21/72
 990001050 WHEN VAPOUR CLEANING WITH TRICHLOROETHYLENE (T.C.E.) APL-SAFETY-DEPT-INFO-SHEET-38 2P 2/10/71
 990001890 LENE, VINYLIDENA-CHLORIDE, TRICHLOROETHYLENE, ETHYL-ALCOHOL, METHYL-ETHYL-KETONE, KEROSENE, GLYCERINE, POLYETH
 990003700 ELMORE, G. APL SHELL AND TUBE-TYPE-COOLERS FOR OXYGEN SERVICE APL-ENGR-SPEC-E.05 13P 6/1/71
 990003690 ELMORE, G. APL SHELL AND TUBE-TYPE-COOLER, OTHER THAN FOR OXYGEN SERVICE (APL-PLANTS) APL-ENGR-SPEC-E.04
 990001890 EP-2-LIQUID, TURCO-4499-1, TUCRO-4499-2, TURCO-4499-3, TURCO-4499-5, TURCO-4499-6, ZYGLO-ZLIB-OIL-BASE, ZYGLO-
 990005240 S-TYPE TCL-100 OR DTD-5019 TUNGUM CO LTD/UK COMPOSITION- COPPER-86-PERCENT ALUM-1.20-PERCENT NICKEL-1.4-P
 990001890 O-DYE-CHECK-STEP-2-LIQUID, TURCO-4499-1, TUCRO-4499-2, TURCO-4499-3, TURCO-4499-5, TURCO-4499-6, ZYGLO-ZLIB-OI
 990001890 URCO-4499-1, TUCRO-4499-2, TURCO-4499-3, TURCO-4499-5, TURCO-4499-6, ZYGLO-ZLIB-OIL-BASE, ZYGLO-ZL-2-PENETREX,
 990001890 URCO-4499-2, TURCO-4499-3, TURCO-4499-5, TURCO-4499-6, ZYGLO-ZLIB-OIL-BASE, ZYGLO-ZL-2-PENETREX, ZYGLO-ZL-22,
 990001890 URCO-4499-3, TURCO-4499-5, TURCO-4499-6, ZYGLO-ZLIB-OIL-BASE, ZYGLO-ZL-2-PENETREX, ZYGLO-ZL-22, ZYGLO-ZLX-390,
 990001890 90, DYE-PROCESS-SOLUTIONS, TURCO-DYE-CHECK PROCESS, ZYGLO-ZE-2-EMULSIFIER, ZYGLO-ZP-5-DEVELOPER, PROTECTIVE-CO
 990001890 UGLO-PASTE10 IN KEROSENE, TURCO-DYE-CHECK-STEP-2-LIQUID, TURCO-4499-1, TUCRO-4499-2, TURCO-4499-3, TURCO-4499
 990003900 SON, I. APL ACCIDENT AT 1 TURNER LTD PARK/LANE ROYTUN OLDHAM LANCASTER 11940 AM 5/2/70 APL-SAFETY-DEP
 990004840 NATURAL-UNTREATED-FINISH TURNERS ASBESTOS CEMENT CO LTD/UK APCI-IA5A-12 1P 2/21/72
 990000710 RDS- OXYGEN-PRESSURE-GAUGE TWF WCOL, SPINTEX-305, MOLYKOTE-TYPE-Z AND TYPE-X-15 APCI-MAR-87-0-8822 1P 3/6
 990003120 OXYGEN COMPATABILITY WITH TWO-PART EPOXY-COMPOUND (7343-RESIN- 7139-CATALYST) FROM CREST PRODUCTS CO AP
 990004860 CEMENTABLE PTFE TAPES TYGADURE LTD/UK APCI-IA5A-14 1P 2/21/72
 990004860 PCI GASKETS AND PACKINGS- TYCAFLUK CEMENTABLE PTFE TAPES TYGADURE LTD/UK APCI-IA5A-14 1P 2/21/72
 990000750 YPE CUTTING-OILS, KNOWN AS TYPE-GROUP-II, PLANT WASH-OUT STUDIES, CELLULOSE-300, CELLULOSE-220 APCI-MAR-87-0

990001400 0, UCON-LB300, UCON-LB170, UCON-HB170, UCON-HB660, AURALUBE-FS, FLUOROLUBE-FS5, KEL-F-LF3, VERSILUBE-F-50, SF8
 990001400 0, UCON-LB170, UCON-HB170, UCON-HB660, AURALUBE-FS, FLUOROLUBE-FS5, KEL-F-LF3, VERSILUBE-F-50, SF8L(40)-SILICU
 990001400 3, UCON-LB550, UCON-LB300, UCON-LB170, UCON-HB170, UCON-HB660, AURALUBE-FS, FLUOROLUBE-FS5, KEL-F-LF3, VERSILU
 990001400 LULUBE-220, CELLULUBE-150, UCON-LB283, UCON-LB550, UCON-LB300, UCON-LB170, UCON-HB170, UCON-HB660, AURALUBE-FS
 990001400 0, UCON-LB283, UCON-LB550, UCON-LB170, UCON-HB170, UCON-HB660, AURALUBE-FS, FLUOROLUBE-FS5, KEL-F-
 990001400 CELLULUBE-150, UCON-LB283, UCON-LB550, UCON-LB300, UCON-LB170, UCON-HB170, UCON-HB660, AURALUBE-FS, FLUOROLUBE
 990000590 US, AND EXPLOSION TESTING- UCON-TYPE LUBRICANTS, STEEL-PIPES APCI-MAR-87-0-8820 IP 4/61
 990002920 DEW-POINT OF AIR-SYSTEMS UNARCG APCI-MEMO-63 11/17/63 3P
 990003440 E OF BUILDING OFFICIALS UNIFORM BUILDING CODE VOL-1 1970
 990001940 FLEET SAFETY- LOADING AND UNLOADING OPERATIONS APCI-SAFETY-STD-635.19 6P 2/68
 990005570 CRT TO SYSTEM LOADING AND UNLOADING PROCEDURES FOR LIQUID OXYGEN TRANSFER APCI-IIIF1-2 IP 8/22/71
 990003770 PEGRAM, J.W. APL UNSINTERED P.T.F.E. TAPE APL-ENGR-SPEC-L-14 2P 7/8/69
 990002920 CRYOGENIC SYSTEMS MILFOAM URETHANE INSULATION NATIONAL-GYPSUM-BLUE LOX-SYSTEMS FOAM-GLASS LIQUID-HYDROGEN-PIP
 990000110 SCHMUYER, W.W. APCI VACUUM PUMP FAILURES APCI-SAFETY-GRAM-NO-35 IP 10/4/63
 990002760 KITSON, F.K. APCI NASH VACUUM PUMPS APCI-MEMO-71 01/19/71 2P
 990000490 PLANT COMPONENTS- STORAGE, VACUUM-SYSTEMS, AND COMPRESSED-GASES APCI-SAFETY-STD-607.2.2.5 PI-4 3/65 P5-6
 990004750 PCI GASKETS AND PACKINGS- VALLEGREEN, VALLEY/FORGE GASKET CO APCI-IA5A-03 IP 2/21/72
 990001460 GRE-CO, MELRATH-GASKET-CO, VALLEY-FURGE-GASKET-CO LOX TRANSFER FLUOROGREEN-E-600 APCI-MEMO-70 10/23/70 IP
 990004750 AND PACKINGS- VALLEGREEN, VALLEY/FORGE GASKET CO APCI-IA5A-03 IP 2/21/72
 990003910 I. APL INVESTIGATION OF VALVE FIRES AT TEXAS INSTRUMENTS LTD-BEDFORD APL-SAFETY-DEPT-REP-31 5P REV-1
 990000350 I PIPING- EXTENDED BONNET VALVE CODE APCI-DES-ENG-STD-579.4 3P 4/63
 990000360 APCI PIPING- VALVE PROCUREMENT AND CLEANING PROCEDURE APCI-DES-ENG-STD-579.5 3P 8/12/60
 990002350 COMPRESSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS CGA-PAMPHLET-V-1 57P 1965
 990002370 COMPRESSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS CSA-396 57P 1965
 990002360 COMPRESSED GAS CYLINDER VALVE OUTLET AND INLET CONNECTIONS ASA-87.1 57P 1965
 990001430 MOYAN, S.R. APCI VALVE WASHERS NEW AND USED QUALITATIVE AND QUANTITATIVE OIL ANALYSIS APCI-ANAL-R
 990001850 D TEST OF 1/2-INCH SAFETY VALVES APCI-IIF3A(3)-1 IP 12/30/71
 990001830 PIPING- INTRODUCTION HANG VALVES APCI-DES-ENG-STD-579.3 12P 1/63
 990000240 IREMENTS SAFETY AND RELIEF VALVES APCI-DES-ENG-STD-537.9 4P 7/65
 990000340 I PIPING- STAINLESS-STEEL VALVES AND MATERIAL REQUIREMENTS APCI-DES-ENG-STD-579.3.1 2P 5/64
 990000460 -SEPARATION PLANT, PIPING, VALVES AND SAFETY-RELIEF DEVICES APCI-SAFETY-STD-607.1.12 14P 10/62
 990000360 PEGRAM, J.W. APL VALVES LOCATION AND PIPING-DESIGN CONSIDERATIONS APCI PIPING GROUP MEMO-19 10
 990000370 APL RELIEF VALVES, WARM GAS SERVICE -20F TO 100F APL-ENGR-SPEC-J.18 4P 6/18/69
 990002470 APCI LIX AND LIN VAPOR HAZARDS- SAFETY INFORMATION RELATIVE TO LIQUID-VAPOR-CLOUDS APCI-PAPER 7P
 990002510 MASTER, H.H. APCI PRODUCT VAPOR HAZARDS- SAFETY INFORMATION RELATIVE TO LIQUID-VAPOR-CLOUDS APCI-PAPER 7P
 990000920 SUN-OIL COMPANY'S LOX-TANK VAPORIZER APCI-MEMO-64 04/9/64 IP PLUS IP ATTACHMENT
 990000150 APCI PRESSURE-VESSELS- VAPORIZER AND CRYOGENIC LIQUID DISPOSAL APCI-DES-ENG-STD-514.6.2 4P 5/26/61
 990002970 STEEL LTD OXYGEN PLANT VAPORIZER EXPLOSION AICHE-CEP-TECH-MANJAL SAFETY IN AIR AND AMMONIA PLANTS V
 990002500 M.L. APCI MISTY PROBLEM VAPOR-CLOUDS FROM DEFROST OPERATIONS ALLEGEDLY CAUSED HIGHWAY ACCIDENT APCI-SAFET
 990001030 I. APL FIRE HAZARD WHEN VAPOUR CLEANING WITH TRICHLOROETHYLENE (T.C.E.) APL-SAFETY-DEPT-INFO-SHEET-38 2
 990002930 TS ON INSULATION MATERIALS VASCOCEL MILFOAM NATIONAL-GYPSUM (GREEN) FUAM-GLAS (CORNING) APCI-IMD-NU-LA-033
 990000640 APCI REQUIREMENTS FOR VENDOR CLASS-A CLEANING APCI-QUAL-CONT-LAYOUT-115F 2P 7/1/71
 990000860 APCI REQUIREMENTS FOR VENDOR CLASS-AAA CLEANING APCI-QUAL-CONT-LAYOUT-116F 2P 7/1/71
 990000860 APCI REQUIREMENTS FOR VENDOR CLASS-AAA CLEANING APCI-QUAL-CONT-LAYOUT-117F 3P 7/1/71
 990000860 APCI REQUIREMENTS FOR VENDOR CLASS-B CLEANING APCI-QUAL-CONT-LAYOUT-114F 2P 7/1/71
 990002220 REGARDING REQUIREMENTS FOR VENDOR-CLASS-AAA AND CLASS-AAA CLEANING APCI-MEMO-71 07/22/71 IP
 990005450 UNAL-HAZARDS- DISPOSAL OF VENTED GASES CLEANLINES OF DISPOSAL SYSTEM APCI-IIIF1-1 2P 2/12/72
 990005470 UNAL-HAZARDS, DISPOSAL OF VENTED GASES CLEANLINES OF VENTED GASES CLEANLINES OF OXYGEN PIPING APCI-IIIF1-2 IP 2/19/72
 990005440 UNAL-HAZARDS- DISPOSAL OF VENTED GASES COMPANY PRACTICES APCI-IIIF1-1 5P 11/1/71
 990005460 UNAL-HAZARDS- DISPOSAL OF VENTED GASES PROCEDURAL ARRANGEMENTS APCI-IIIF1-1 IP 2/19/72

990003640 APL ACCIDENT ARISING FROM VENTING-OXYGEN MANIFOLDS CONNECTED TO A COMMON VENT PIPE APL-SAFETY-HULL-075 3
 990001400 FLUOROLUBE-F55, KEL-F-LE3, VESILUBE-F-50, SF61401-SILICONE, PYDRAUL-F-9, GOW-CURRING-4 COMPOUND SILICONE, DO
 990000960 KBLATTER GERMAN PRESSURE VESSEL CODE-AD MERKBLATTER (ENGLISH TRANSLATION) 304P 9/71
 990003660 LOCATION FOR OXYGEN SERVICE VESSEL FABRICATION APL-ENGR-SPEC-C-03 7P 7/26/71
 990002280 APCI CODED VESSEL REPAIRS APCI-PGM-SEC-6.09 4P 11/29/68 FOR ATTCHMTS 11/29/68
 990000180 APCI CODED VESSEL REPAIRS APCI-PGM-SEC-6.09 4P 15P OF ATTCHMTS 11/29/68
 990005740 U PIPELINE TRANSPORTATION VIBRATION AND CONTROLLED SLOSHING APCI-IFFE-1 1P 8/22/71
 990005750 INSULATION SYSTEM DUE TO VIBRATIONS, SHOCK (THERMAL AND PRESSURE), LINE-SURGES APCI-IFFB-1 1P 2/18/72
 990003070 D-OXYGEN TRAILER- ACCIDENT VICTORY-MEMORIAL-HOSPITAL 5/70 APCI-MEMO-71 06/3/71 17P
 990001890 E, TRANS-DICHLORIDE ETHYLENE, VINYLIDENA-CHLORIDE, TRICHLOROETHYLENE, ETHYL-ALCOHOL, METHYL-ETHYL-KETONE, KEROSENE
 990001890 EXAFLUOROPROPYLENE VITON A VINYLIDENA FLUORIDE, POLYDIMETHYLSILOXANE, FLUORINATED-SILOXANE, LS-53, BUTYL-RUBBE
 990001890 GRAPHITE-CHLOR-BIPHENYL, VINYL-CHLORIDE, CIS-DICHLOROETHYLENE, TRANS-DICHLOROETHYLENE, VINYLIDENA-CHLORIDE,
 990001350 DINTING COMPOUND SQ-32 AND VITON A APCI-IMO-81-0095 1P 4/27/66
 990001890 F, POLYHEXAFLUOROPROPYLENE VITON A VINYLIDENO FLUORIDE, POLYDIMETHYLSILOXANE, FLUORINATED-SILOXANE, LS-53, BUT
 990004710 ELASTOMERS, AND ADHESIVES- VITON-A DUPONT APCI-IA4A-06 1P 2/21/72
 990004830 PCI GASKETS AND PACKINGS- VITON-A DUPONT APCI-IA5A-11 1P 2/21/72
 990003040 FRIAL- VITON-E-60 (GREEN) VITON-A (BLACK) GARLOCK-900 JOHNS-MANVILLE ASBESTOS-61 SHEET APCI-ANAL-REP-71
 990003050 /KA-4-IV OXYGEN COMPRESSOR VITON-A (BLACK) VITON-E60 (GREEN) DEMAG-LETTER TO APCI 1P 8/11/71
 990003050 ING VITON-D-RING MATERIAL VITON-E60 (GREEN) DEMAG-LETTER TO APCI 1P 8/11/71
 990003040 PCI OXYGEN INDEX KAITING VITON-G-RING MATERIAL VITON-E-60 (GREEN) VITON-A (BLACK) GARLOCK-900 JOHNS-MANVI
 990004440 APCI LUBRICANTS- VOLTALF-3A KINGSEY AND KEITH LTO/UK APCI-IA1A-16 1P 2/21/72
 990004800 PCI GASKETS AND PACKINGS- VULCANIZED-RED-FIBRE-GASKETS APCI-IA5A-08 1P 2/21/72
 990001890 SAFETY-WALK-TYPE-B-M-0070, WALK-SYNTHETIC-CORK, MASKING-TAPE, SHERLOCK-LEAK-DETECTOR-TYPE-CG, SHERLOCK-LEAK DE
 990003740 J.M. APL RELIEF VALVES, WARM GAS SERVICE -20F TO 100F APL-ENGR-SPEC-J.18 4P 6/18/69
 990005800 APCI SYSTEM-EMERGENCIES APCI-IVB-1 5P 11/12/71
 990001430 MOYSAN,S.R. APCI VALVE WASHERS NEW AND USED QUALITATIVE AND QUANTITATIVE OIL ANALYSIS APCI-ANAL-REP-63-
 990003960 GILLOTTE, APL SOLVENT WASHING OF PIPING SYSTEMS APL-IGD-ENGR-MAN-56-06 4P 7/3/71
 990000730 MN AS TYPE-GROUP-11, PLANT WASH-OUT STUDIES, CELLULUBE-300, CELLULUBE-220 APCI-MAR-87-0-8822 2P 6/63
 990000920 KITSON,F.K. APCI WASH-OUT ANALYSIS OF SUN-OIL COMPANY'S LOX-TANK VAPORIZER APCI-MEMO-64 04/9/64
 990002860 BYRON-JACKSON OXYGEN PUMP WASH-OUT PROCEDURE FOR ANALYTICAL PURPOSES APCI-PUM-SEC-1.07 5P 7/7/70
 990000980 O PLANT EQUIPMENT SOLVENT WASH-OUT-FREQUENCIES APCI-PUM-SEC-5.07 3P 7/15/70
 990003210 IN,C.B. APCI ANALYSIS OF WATER-HAMMER IN CRYOGENIC TRANSFER-LINES BIODIAGNAPHY APCI-REPORT 86 2/28/64
 990003210 APCI
 990002160 RACTURE TOUGHNESS STUDY OF WELDED ALUMINUM ALLOY-5083 ASME WINTER ANNUAL-MEETING NEWYORK 8P 11/29/70-1
 990003430 AND CONSTRUCTION OF LARGE, WELDED, LOW-PRESSURE STORAGE TANKS API STANDARD-620 2/70
 990005390 PATIBILITY FABRICATION AND WELDING APCI-IB2D-1 2P 10/28/71
 990002110 QUALIFICATION STANDARD FOR WELDING AND BRAZING PROCEDURES, WELDERS, BRAZERS, AND WELDING AND BRAZING UPER
 990002440 YGEN-FUEL GAS SYSTEMS FOR WELDING AND CUTTING NFA-ND-51 8P 1969 AND CUTTING AND WELDING PROCESSES NF
 990002720 ELUING SOCIETY SAFETY IN WELDING AND CUTTING USAS-Z49.1 49P 1967
 990002890 FOR AIR-PRODUCTS REIDI-SET WELDING AND CUTTING OUTFITS APCI-BROCHURE 11P 9/25/69
 990000140 OXYGEN REGULATORS IN THE WELDING INDUSTRY APCI-SAFETY-GRAM-ND-60C 5P 11/26/67
 990001110 T CONCRETE FLOOR TREATMENT WEST CHEMICAL PRODUCTS INC, ALUMINUM-OXIDE, SEAM COMPOUND GEON POLYVINYLCHLORIDE,
 990000110 -NEW/BRUNSWICK/NEW/JERSEY, WEST CONCRETE FLOOR TREATMENT WEST CHEMICAL PRODUCTS INC, ALUMINUM-OXIDE, SEAM CO
 990004890 EATMENTS- PLASITE-MO-7122H MISCOSIN PROTECTIVE COATING CO APCI-146A-03 1P 2/21/72
 990000640 UN TESTING- PINE AND MAPLE WOOD, ACTIVATED CARBON APCI-MAR-87-0-8821 1P 10/61
 990000410 URES, THERMAL TANKS, GLASS WOOD APCI-DES-ENG-STD-981.3 1P 10/24/60
 990001450 QUALITY CONTROL OF ROCK WOOL APCI-REHU 2 HINMELBERGER,F. APCI QUALITY CONTROL OF ROCK WOOL APCI-ME
 990001450 QUALITY CONTROL OF ROCK WOOL APCI-MEND-59 11/6/59 2P
 990003800 PLORAM,J.W. APL MINERAL WOOL APL-ENGR-SPEC-N-02 3P 1/2/70

990001470 APCI PRODUCTION OF ROCK WOOL BETHLEHEM-STEEL-CO APCI-MEMO-59 11/12/59 2P
990001310 TANCE OF FIBERIZED MINERAL WOOL INSULATION APCI-QUAL-CONT-LAYOUT-103L 2P 7/1/71
990000710 OXYGEN-PRESSURE-GAUGE THF WOOL, SPINTEX-305, MOLYKOTE-TYPE-2 AND TYPE-X-15 APCI-MAR-87-0-8822 1P 3/63
990002030 CONTROL PROCEDURE- SAFETY WORK-PERMIT APCI-POM-SEC-1.04 3P PLUS EXHIBIT-A 1P 2/16/67
990004200 LACK OF OXYGEN KILLS TWO WORKMEN APL-SAFETY-BULL-037 1P REPRINTED 1/68

990003880 NARY REPORT ON ACCIDENT AT ZELZATE PLANT 2/26/69 WHEN AN EXPLOSION AND FIRE OCCURRED IN BURCKHARDT CENTRIFUG
990005230 POSITION CU-58 1-PERCENT ZN38.5-42-PERCENT P80.35-.9-PERCENT APCI-1A6A-37 1P 2/21/72
990001890 TURCO-DYE-CHECK PROCESS, ZYGLO-ZE-2-EMULSIFIER, ZYGLO-ZP-5-DEVELOPER, PROTECTIVE-COATINGS, DOW-CORNING-SILIC
990001890 URCO-4499-5, TURCO-4499-6, ZYGLO-ZL18-OIL-BASE, ZYGLO-ZL-2-PENETREX, ZYGLO-ZL-22, ZYGLO-ZLX-390, DYE-PROCESS-S
990001890 BASE, ZYGLO-ZL-2-PENETREX, ZYGLO-ZL-22, ZYGLO-ZLX-390, DYE-PROCESS-SOLUTIONS, TURCO-DYE-CHECK PROCESS, ZYGLO-Z
990001890 99-6, ZYGLO-ZL18-OIL-BASE, ZYGLO-ZL-2-PENETREX, ZYGLO-ZL-22, ZYGLO-ZLX-390, DYE-PROCESS-SOLUTIONS, TURCO-DYE-C
990001890 L-2-PENETREX, ZYGLO-ZL-22, ZYGLO-ZLX-390, DYE-PROCESS-SOLUTIONS, TURCO-DYE-CHECK PROCESS, ZYGLO-ZE-2-EMULSIFIE
990001890 SS, ZYGLO-ZE-2-EMULSIFIER, ZYGLO-ZP-5-DEVELOPER, PROTECTIVE-COATINGS, DOW-CORNING-SILICONE, PAINT-ON-GALBESTOS

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| 99000380 | SYSTEM EL/SEGUNDO/CALIF | APCI-CUNSTR-SPEC-200.0 TO 200.20 | 20P | 8/7/70 |
| 990001020 | STEEL PIPE AND FITTINGS | APCI-CUNSTR-SPEC-200.16.1.7 TO 200.16.3.2 | P14-20 7P | 2/3/67 |
| 990001010 | APCI CLEANING | APCI-CUNSTR-SPEC-230.15 ON P8 | 1P | 9/16/69 |
| 990002540 | APCI ACCIDENT REPORTING | APCI-CORP-ADMIN-PROC N-1.5 | 3P | 4/1/68 |
| 990000180 | SIS AND GENERAL STANDARDS | APCI-DES-ENG-STD-510.1 | 6P | 8/62 |
| 990000190 | MATERIALS OF CONSTRUCTION | APCI-DES-ENG-STD-510.1.4 | 4P | 6/62 |
| 990000200 | URE-VESSELS- SHELL-DESIGN | APCI-DES-ENG-STD-510.2 | 4P | 2/65 |
| 990000210 | SURE-VESSELS- HEAD-DESIGN | APCI-DES-ENG-STD-510.3 | 13P | 8/62 |
| 990000150 | CRYOGENIC LIQUID DISPOSAL | APCI-DES-ENG-STD-514.6.2 | 4P | 5/26/61 |
| 990000160 | S OXYGEN STORAGE CYLINDER | APCI-DES-ENG-STD-515.1.3 | 3P | 10/17/60 |
| 990002820 | G PRESSURE-GAUGES SNUBBER | APCI-DES-ENG-STD-531.10.2 | 2P | 12/5/61 |
| 990000220 | TION- PRESSURE INDICATORS | APCI-DES-ENG-STD-531.2 | 5P | 10/63 |
| 990002430 | PCI OXYGEN CONTROL-PANEL | APCI-DES-ENG-STD-534.1 (TO BE PUBLISHED) | | |
| 990000230 | ETTINGS OF SAFETY DEVICES | APCI-DES-ENG-STD-537.1 | 6P | 4/21/59 |
| 990000240 | SAFETY AND RELIEF VALVES | APCI-DES-ENG-STD-537.9 | 4P | 7/65 |
| 990000250 | HIELDS AND OXYGEN-SYSTEMS | APCI-DES-ENG-STD-546.1 | 9P | 1/15/71 |
| 990000260 | CATING OXYGEN COMPRESSORS | APCI-DES-ENG-STD-551.1.9.1 | 14P | 2/3/71 |
| 990000270 | IFUGAL OXYGEN COMPRESSORS | APCI-DES-ENG-STD-551.2.8.1 | 18P | 2/3/71 |
| 990001180 | GVED PIPE THREAD SEALANTS | APCI-DES-ENG-STD-570.5.1 | 1P | 11/11/60 |
| 990000290 | XYGEN COMPRESSOR LOCATION | APCI-DES-ENG-STD-570.6 | 2P | 1/15/71 |
| 990002560 | R SYSTEM APCI OPERATED | APCI-DES-ENG-STD-570.7 | 32P | 7/19/71 |
| 990001550 | READED-ENDS ALUMINUM-PIPE | APCI-DES-ENG-STD-571.1 | 5P | 10/65 |
| 990001560 | 30PSIG-MAX-OWG ALUMINUM | APCI-DES-ENG-STD-571.2 | 3P | 11/67 |
| 990001570 | 150-PSIG-MAX-OWG ALUMINUM | APCI-DES-ENG-STD-571.3 | 4P | 11/67 |
| 990001580 | 300-PSIG-MAX-OWG ALUMINUM | APCI-DES-ENG-STD-571.4 | 3P | 11/67 |
| 990001590 | SIG-MAX-OWG ALUMINUM-TUBE | APCI-DES-ENG-STD-571.50 | 2P | 11/1/68 |
| 990001600 | SIG-MAX-OWG ALUMINUM-TUBE | APCI-DES-ENG-STD-571.51 | 2P | 11/1/68 |
| 990001510 | ADED-ENDS- RED BRASS-PIPE | APCI-DES-ENG-STD-572.1 | 5P | 5/62 |
| 990001610 | S- PLAIN-ENDS COPPER-TUBE | APCI-DES-ENG-STD-574.1 | 5P | 5/62 |
| 990001630 | PSIG-MAX-OWG COPPER-TUBE | APCI-DES-ENG-STD-574.10 | 3P | 1/64 |
| 990001620 | PSIG-MAX-OWG COPPER-TUBE | APCI-DES-ENG-STD-574.2 | 3P | 1/64 |
| 990001640 | -PSIG-MAX-OWG COPPER-TUBE | APCI-DES-ENG-STD-574.50 | 2P | 11/1/68 |
| 990001650 | -PSIG-MAX-OWG COPPER-TUBE | APCI-DES-ENG-STD-574.51 | 2P | 11/1/68 |
| 990001660 | -PSIG-MAX-OWG COPPER-TUBE | APCI-DES-ENG-STD-574.52 | 1P | 4/67 |
| 990001670 | -PSIG-MAX-OWG COPPER-TUBE | APCI-DES-ENG-STD-574.54 | 2P | 1/64 |
| 990001840 | MAX-OWG CARBON STEEL-PIPE | APCI-DES-ENG-STD-578.10.19 | 2P | 6/62 |
| 990001680 | D-ENDS- CARBON STEEL-PIPE | APCI-DES-ENG-STD-578.10.1 | 6P | 10/65 |
| 990001690 | PSIG-MAX-OWG CARBON STEEL | APCI-DES-ENG-STD-578.10.2 | 4P | 10/69 |
| 990001700 | MAX-OWG CARBON STEEL-PIPE | APCI-DES-ENG-STD-578.10.3 | 3P | 6/62 |
| 990001710 | MAX-OWG CARBON STEEL-PIPE | APCI-DES-ENG-STD-578.10.4 | 4P | 1/64 |
| 990001720 | MAX-OWG CARBON STEEL-PIPE | APCI-DES-ENG-STD-578.10.5 | 4P | 1/64 |
| 990001730 | PSIG-MAX-OWG CARBON STEEL | APCI-DES-ENG-STD-578.10.6 | 3P | 6/62 |
| 990001740 | NDS- STAINLESS STEEL-PIPE | APCI-DES-ENG-STD-578.30.1 | 7P | 5/62 |
| 990001810 | -OWG STAINLESS STEEL-PIPE | APCI-DES-ENG-STD-578.30.15 | 4P | 11/67 |
| 990001750 | -OWG STAINLESS STEEL-PIPE | APCI-DES-ENG-STD-578.30.2 | 4P | 11/67 |
| 990001760 | -OWG STAINLESS STEEL-PIPE | APCI-DES-ENG-STD-578.30.3 | 4P | 11/67 |
| 990001770 | -OWG STAINLESS STEEL-PIPE | APCI-DES-ENG-STD-578.30.4 | 3P | 1/64 |
| 990001780 | -OWG STAINLESS STEEL-PIPE | APCI-DES-ENG-STD-578.30.5 | 3P | 1/64 |
| 990001790 | -OWG STAINLESS STEEL-PIPE | APCI-DES-ENG-STD-578.30.6 | 3P | 1/64 |
| 990001800 | -OWG STAINLESS STEEL-PIPE | APCI-DES-ENG-STD-578.30.8 | 3P | 1/64 |
| 990001820 | -MAX STAINLESS STEEL-PIPE | APCI-DES-ENG-STD-578.40.1 | 3P | 9/69 |
| 990000280 | CI PIPING- OXYGEN-PIPING | APCI-DES-ENG-STD-578.60.1 | 14P | 4/24/72 |
| 990000300 | 50-PSIG-MAX CARBON-STEEL | APCI-DES-ENG-STD-578.60.3 | 3P | 9/69 |
| 990000310 | 75-PSIG-MAX CARBON-STEEL | APCI-DES-ENG-STD-578.60.4 | 3P | 9/69 |

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| 990000320 | SIG-MAX-OWG CARBON-STEEL | APCI-DES-ENG-STU-578.60.5 | 3P | 9/69 |
| 990000330 | 20-PSIG-MAX CARBON-STEEL | APCI-DES-ENG-STD-578.60.6 | 3P | 9/69 |
| 990000370 | UMINUM TO STAINLESS-STEEL | APCI-DES-ENG-STD-579.15 | 2P | 9/66 |
| 990001830 | REDUCTION HAND VALVE-CODE | APCI-DES-ENG-STD-579.3 | 12P | 1/63 |
| 990000340 | AND MATERIAL REQUIREMENTS | APCI-DES-ENG-STD-579.3.1 | 2P | 5/64 |
| 990000350 | TENDED BONNET VALVE CODE | APCI-DES-ENG-STD-579.4 | 3P | 4/63 |
| 990000360 | NT AND CLEANING PROCEDURE | APCI-DES-ENG-STD-579.5 | 3P | 8/12/60 |
| 990000390 | XES THERMAL TANKS PERLITE | APCI-DES-ENG-STD-581.1 | 4P | 5/26/61 |
| 990000400 | MINERAL FIBER GRANULATED | APCI-DES-ENG-STD-581.2 | 2P | 6/26/69 |
| 990000410 | THERMAL TANKS, GLASS WOOL | APCI-DES-ENG-STD-581.3 | 1P | 10/24/60 |
| 990002230 | QUALITY CONTROL PROGRAM | APCI-DIST-OPER-MAN-6.3 | 6P | 7/65 1/69 4/68 PLUS EXHIBIT-A AND B 7/19/65 |
| 990002390 | LLON CAPACITY OR LARGER) | APCI-DIST-OPER-MAN-9.1 | 6P | PLUS EXHIBITS ABC 4/66 |
| 990001930 | D CUSTOMER INSTALLATIONS | APCI-DIST-OPER-MAN-V-1-SEC-4.2.3 | 1P | 5/69 |
| 990001920 | R BULK GAS SUPPLY SYSTEM | APCI-DIST-OPER-MAN-V-1-SEC-4.1.3 | 2P | 6/71 |
| 990002260 | YES REQUIREMENTS SUMMARY | APCI-DIST-OPER-MAN-V-1-SEC-6.32 | 7P | 3/70 |
| 990003080 | G 1200-SERIES REGULATIONS | APCI-DRAWING-000-0-407004E | 1P | 3/4/66 |
| 990002340 | GEN PUMP FILTER ASSEMBLY | APCI-DRAWING-58521C | REV-B | 12/18/57 |
| 990002470 | PUR DISPOSAL-TANK-500-GAL | APCI-DRAWING-924830 | REV-B | 9/30/68 |
| 990004290 | KRYTOX-143-AA-GIL DUPONT | APCI-IA1A-01 | 1P | 2/21/72 |
| 990004300 | HALOCARBON PRODUCTS CORP | APCI-IA1A-02 | 1P | 2/21/72 |
| 990004310 | HALOCARBON PRODUCTS CORP | APCI-IA1A-03 | 1P | 2/21/72 |
| 990004320 | HALOCARBON PRODUCTS CORP | APCI-IA1A-04 | 1P | 2/21/72 |
| 990004330 | NING MANUFACTURING CU | APCI-IA1A-05 | 1P | 2/21/72 |
| 990004340 | HALOCARBON PRODUCTS CORP | APCI-IA1A-06 | 1P | 2/21/72 |
| 990004350 | LUBE, FS, HOOKER CHEMICAL | APCI-IA1A-07 | 1P | 2/21/72 |
| 990004360 | KRYTOX-143-AB-OIL DUPONT | APCI-IA1A-08 | 1P | 2/21/72 |
| 990004370 | KRYTOX-143-AC-OIL DUPONT | APCI-IA1A-09 | 1P | 2/21/72 |
| 990004380 | KRYTOX-143-AZ-OIL DUPONT | APCI-IA1A-10 | 1P | 2/21/72 |
| 990004390 | BE, FS-5, HOOKER CHEMICAL | APCI-IA1A-11 | 1P | 2/21/72 |
| 990004400 | L-RAY CO FARMINGDALE/NJ | APCI-IA1A-12 | 1P | 2/21/72 |
| 990004410 | BE PRODUCTS GLEN/COVE/NY | APCI-IA1A-13 | 1P | 2/21/72 |
| 990004420 | UORO-GLIDE, CHEMPLAST INC | APCI-IA1A-14 | 1P | 2/21/72 |
| 990004430 | KRYTOX-143-AD-OIL DUPONT | APCI-IA1A-15 | 1P | 2/21/72 |
| 990004440 | NGSLEY AND KEITH LTD/UK | APCI-IA1A-16 | 1P | 2/21/72 |
| 990004450 | BRICANTS- ESSO BEACON-325 | APCI-IA1A-17 | 1P | 2/21/72 |
| 990004460 | IN-Y04 MONTECATINI-EDISON | APCI-IA1A-18 | 1P | 2/21/72 |
| 990004470 | COMPOUNDS- PERMATEX-1516 | APCI-IA2A-01 | 1P | 2/21/72 |
| 990004480 | NDS- TEFLON-TAPE PERMACEL | APCI-IA2A-02 | 2P | 2/21/72 |
| 990004490 | NDS- T-FILM ECO MFGR CU | APCI-IA2A-03 | 1P | 2/21/72 |
| 990004500 | NATIONAL GREENHOUSE CU | APCI-IA2A-04 | 1P | 2/21/72 |
| 990004510 | L-RAY CO FARMINGDALE/NJ | APCI-IA2A-05 | 1P | 2/21/72 |
| 990004520 | USSLITE-FLUOROCARBON-TAPE | APCI-IA2A-06 | 2P | 2/21/72 |
| 990004530 | ING COMPOUNDS- DAMCO TAPE | APCI-IA2A-07 | 2P | 2/21/72 |
| 990004540 | NG COMPOUNDS- SANDEN TAPE | APCI-IA2A-08 | 2P | 2/21/72 |
| 990004550 | - CRANE PACKING CO-TAPE | APCI-IA2A-09 | 2P | 2/21/72 |
| 990004560 | READING COMPOUNDS- GOMAT | APCI-IA2A-10 | 1P | 2/21/72 |
| 990004570 | THREE-M FLUOROCARBON-TAPE | APCI-IA2A-11 | 2P | 2/21/72 |
| 990004580 | CATE AND CHINA-CLAY-PASTE | APCI-IA2A-12 | 1P | 2/21/72 |
| 990004590 | PITTSBURGH-CORNING CORP | APCI-IA3A-01 | 1P | 2/21/72 |
| 990004600 | TRANSITE, JOHNS-MANVILLE | APCI-IA3A-02 | 1P | 2/21/72 |
| 990004610 | INSULATIONS- GLASS-WOOL | APCI-IA3A-03 | 1P | 2/21/72 |
| 990004620 | INSULATIONS- MINERAL-WOOL | APCI-IA3A-04 | 1P | 2/21/72 |
| 990004630 | CAL INSULATIONS- PERLITE | APCI-IA3A-05 | 1P | 2/21/72 |
| 990004640 | ONS- MILFOAM MILFOAM CORP | APCI-IA3A-06 | 1P | 2/21/72 |

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| 990004650 | BLUE NATIONAL-GYPSUM CORP | APCI-IA3A-01 | 1P | 2/21/72 |
| 990004660 | MOLITE-12-CURING-CATALYST | APCI-IA4A-01 | 1P | 2/21/72 |
| 990004670 | D ADHESIVES- KEENE-BINDER | APCI-IA4A-02 | 1P | 2/21/72 |
| 990004680 | AND ADHESIVES- KEL-F-81 | APCI-IA4A-03 | 1P | 2/21/72 |
| 990004690 | ERS, AND ADHESIVES- NYLON | APCI-IA4A-04 | 1P | 2/21/72 |
| 990004700 | AND ADHESIVES- NEOPRENE | APCI-IA4A-05 | 1P | 2/21/72 |
| 990004710 | ADHESIVES- VITON-A DUPONT | APCI-IA4A-06 | 1P | 2/21/72 |
| 990004720 | VES- NYLON-66 ICI LTD/UK | APCI-IA4A-07 | 1P | 2/21/72 |
| 990004730 | REGNATED-ASBESTOS-PACKING | APCI-IA5A-01 | 1P | 2/21/72 |
| 990004740 | FEN, MELRATH GASKETS CU | APCI-IA5A-02 | 1P | 2/21/72 |
| 990004750 | VALLEY/FURGE GASKET CU | APCI-IA5A-03 | 1P | 2/21/72 |
| 990004760 | REEN-E-600, JOHN/DORE CU | APCI-IA5A-04 | 1P | 2/21/71 |
| 990004770 | SBESTOS GASKET MATERIAL | APCI-IA5A-05 | 1P | 2/21/72 |
| 990004780 | AL NICOLET INDUSTRIES INC | APCI-IA5A-06 | 1P | 2/21/72 |
| 990004790 | ATERIAL) GARLOCK MFG CO | APCI-IA5A-07 | 1P | 2/21/72 |
| 990004800 | CANIZED-RED-FIBRE-GASKETS | APCI-IA5A-08 | 1P | 2/21/72 |
| 990004810 | TEKIAL NICOLET INDUSTRIES | APCI-IA5A-09 | 1P | 2/21/72 |
| 990004820 | PACKINGS- TEFLON, DUPONT | APCI-IA5A-10 | 2P | 2/21/72 |
| 990004830 | PACKINGS- VITON-A DUPONT | APCI-IA5A-11 | 1P | 2/21/72 |
| 990004840 | STUS CEMENT CU LTD/UK | APCI-IA5A-12 | 1P | 2/21/72 |
| 990004850 | | APCI-IA5A-13 | 1P | 2/21/72 |
| 990004860 | E TAPES TYGADURE LTD/UK | APCI-IA5A-14 | 1P | 2/21/72 |
| 990004870 | T PITTSBURGH CHEMICAL CO | APCI-IA6A-01 | 1P | 2/21/72 |
| 990004880 | L-97 BENJAMIN FOSTER CU | APCI-IA6A-02 | 1P | 2/21/72 |
| 990004890 | PROTECTIVE COATING CU | APCI-IA6A-03 | 1P | 2/21/72 |
| 990004900 | NTS- COPPER-PIPE ASTM-B42 | APCI-IA6A-04 | 1P | 2/21/72 |
| 990004910 | NTS- COPPER-TUBE ASTM-B75 | APCI-IA6A-05 | 1P | 2/21/72 |
| 990004920 | - RED-BRASS-PIPE ASTM-B43 | APCI-IA6A-06 | 1P | 2/21/72 |
| 990004930 | LUMINUM ASTM-B211-2024-T4 | APCI-IA6A-07 | 2P | 2/21/72 |
| 990004940 | ALUMINUM, ASTM-B-210-3003 | APCI-IA6A-08 | 2P | 2/21/72 |
| 990004950 | ALUMINUM ASTM-B209-5083-0 | APCI-IA6A-09 | 2P | 2/21/72 |
| 990004960 | LUMINUM ASTM-B210-6061-T6 | APCI-IA6A-10 | 2P | 2/21/72 |
| 990004970 | LUMINUM ASTM-B241-6061-T6 | APCI-IA6A-11 | 2P | 2/21/72 |
| 990004980 | LUMINUM ASTM-B247-6061-T6 | APCI-IA6A-12 | 2P | 2/21/72 |
| 990004990 | - ALUMINUM B361-MP6061-T6 | APCI-IA6A-13 | 2P | 2/21/72 |
| 990005000 | N STEEL (OXYGEN SERVICE) | APCI-IA6A-14 | 3P | 2/21/72 |
| 990005010 | ESS STEEL ASTM-A312-TP304 | APCI-IA6A-15 | 2P | 2/21/72 |
| 990005020 | NLESS STEEL ASTM-A240-304 | APCI-IA6A-16 | 2P | 2/21/72 |
| 990005030 | 03-WP304 AND A403-WP304L | APCI-IA6A-17 | 2P | 2/21/72 |
| 990005040 | ESS STEEL ASTM-A320-B8304 | APCI-IA6A-18 | 2P | 2/21/72 |
| 990005050 | ESS STEEL ASTM-A194-8T321 | APCI-IA6A-19 | 2P | 2/21/72 |
| 990005060 | S-TYPE-416-CADMIUM-PLATED | APCI-IA6A-20 | 1P | 2/21/72 |
| 990005070 | F-304 AND ASTM-A182-F-316 | APCI-IA6A-21 | 2P | 2/21/72 |
| 990005080 | ENTIFIED AS TO ASTM-SPEC | APCI-IA6A-22 | 2P | 2/21/72 |
| 990005090 | PPER-SILICON ASTM-B9868B | APCI-IA6A-23 | 2P | 2/21/72 |
| 990005100 | MENTS- FREE-MACHING BRASS | APCI-IA6A-24 | 2P | 2/21/72 |
| 990005110 | ATMENTS- BERYLLIUM COPPER | APCI-IA6A-25 | 2P | 2/21/72 |
| 990005120 | NLESS STEEL ASTM-A269-304 | APCI-IA6A-26 | 2P | 2/21/72 |
| 990005130 | - BRONZE ASTM-B61 OR B62 | APCI-IA6A-27 | 2P | 2/21/72 |
| 990005140 | - SHEET GR PLATE ASTM-B36 | APCI-IA6A-28 | 2P | 2/21/72 |
| 990005150 | EATMENTS- MONEL ASTM-B164 | APCI-IA6A-29 | 2P | 2/21/72 |
| 990005160 | SS STEEL ASTM-A351-GK-CF8 | APCI-IA6A-30 | 2P | 2/21/72 |
| 990005170 | NICKEL STEEL ASTM-A35368 | APCI-IA6A-31 | 2P | 2/21/72 |
| 990005180 | TS- COPPER-TUBE ASTM-888 | APCI-IA6A-32 | 1P | 2/21/72 |

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| 990005190 | IBLE EXPOSURE TO OXYGEN | APCI-IA6A-33 | 3P | 2/21/72 |
| 990005200 | NTIMENTAL-STANDARD-GGG-58 | APCI-IA6A-34 | 1P | 2/21/72 |
| 990005210 | URFACE TREATMENTS- SILVER | APCI-IA6A-35 | 1P | 2/21/72 |
| 990005220 | STABILIZER BALANCE FE | APCI-IA6A-36 | 1P | 2/21/72 |
| 990005230 | PERCENT PbO.35-.9-PERCENT | APCI-IA6A-37 | 1P | 2/21/72 |
| 990005240 | K-PERCENT-ZINC-REMAINDER | APCI-IA6A-38 | 1P | 2/21/72 |
| 990005250 | MISC- 1:1 DICHLOROTHANE | APCI-IA7A-01 | 1P | 2/21/72 |
| 990005260 | C- 1,1,1 TRICHLOROETHANE | APCI-IA7A-02 | 1P | 2/21/72 |
| 990005270 | TS, AND MISC- CHLOROFORM | APCI-IA7A-03 | 1P | 2/21/72 |
| 990005280 | ISC- CARBON-TETRACHLORIDE | APCI-IA7A-04 | 1P | 2/21/72 |
| 990005290 | MISC- TRICHLOROETHYLENE | APCI-IA7A-05 | 1P | 2/21/72 |
| 990005300 | MISC- METHYLENE-CHLORIDE | APCI-IA7A-06 | 1P | 2/21/72 |
| 990005310 | CLEANING-PROCEDURES-APCI | APCI-IB1C-01 | 14P | 2/21/72 |
| 990005320 | CLEANING-PROCEDURES-APL | APCI-IB1C-02 | 1P | 2/21/72 |
| 990005330 | TY-CONTROL, FIRE HAZARDS | APCI-IB1D(1)-1 | 2P | 9/9/71 |
| 990005340 | ITY, QUALITY-CONTROL-APCI | APCI-IB1D(2)-1 | 3P | 9/9/71 |
| 990005350 | LITY, QUALITY-CONTROL-APL | APCI-IB1D(2)-2 | 2P | 2/21/72 |
| 990005370 | L-MATERIALS-COMPATIBILITY | APCI-IB2A-1 | 2P | 9/2/71 |
| 990005380 | -SENSITIVITY OF MATERIALS | APCI-IB2C-1 | 1P | 9/2/71 |
| 990005390 | Y FABRICATION AND WELDING | APCI-IB2D-1 | 2P | 10/28/71 |
| 990005400 | RTS SUITABILITY CONTROLS | APCI-IB2E(2)-1 | 1P | 9/2/71 |
| 990005360 | L-MATERIALS-COMPATIBILITY | APCI-IB2-1 | 2P | 2/10/72 |
| 990005420 | CATED OX STORAGE TANKS | APCI-IIA4-1 | 1P | 12/30/71 |
| 990005430 | OTIUM LOX STORAGE TANKS | APCI-IIA4-2 | 1P | 12/30/71 |
| 990005410 | NAL-HAZARDS- OVERPRESSURE | APCI-IIA-1 | 2P | 2/18/72 |
| 990005450 | INESS OF DISPOSAL SYSTEM | APCI-IIB1-1 | 2P | 2/12/72 |
| 990005470 | NLINESS OF OXYGEN PIPING | APCI-IIB1-2 | 1P | 2/19/72 |
| 990005480 | S PROCEDURAL ARRANGEMENTS | APCI-IIB4-1 | 1P | 2/19/72 |
| 990005440 | BASES COMPANY PRACTICES | APCI-IIB-1 | 5P | 11/1/71 |
| 990005490 | OUPLING TO OTHER SYSTEMS | APCI-IIC1-1 | 1P | 12/22/71 |
| 990005490 | ER SYSTEMS APCI-IIC1-1 | APCI-IIC2-1 | 1P | 12/22/71 |
| 990005510 | ATE DISPOSAL ARRANGEMENTS | APCI-IID1-1 | 2P | 8/22/71 |
| 990005520 | KCES IN DISPOSAL SYSTEMS | APCI-IID2-1 | 1P | 8/22/71 |
| 990005530 | NINGS AND ESCAPE SYSTEMS | APCI-IID3-1 | 1P | 8/22/71 |
| 990005540 | ND RESPONSE TIME LIMITS | APCI-IID4-1 | 1P | 8/22/71 |
| 990005500 | ZARDS- SPILLS AND LEAKAGE | APCI-IID-1 | 2P | 9/3/71 |
| 990005550 | CONTAMINANTS ACUMULATION | APCI-IIE-1 | 1P | 7/21/71 |
| 990005560 | ORT, TRANSPORT TO SYSTEM | APCI-IIF1-1 | 1P | 12/22/71 |
| 990005570 | LIQUID OXYGEN TRANSFER | APCI-IIF1-2 | 1P | 8/22/71 |
| 990005580 | NIC LIQUID STORAGE TANKS | APCI-IIF1-3 | 1P | 2/3/72 |
| 990005590 | OCEDURES FOR LIQUID PUMPS | APCI-IIF1-4 | 1P | 2/21/72 |
| 990005620 | ION CONTAMINATION-CONTROL | APCI-IIF2A-1 | 1P | 8/22/71 |
| 990005630 | AL FROM VENTS AND LINES | APCI-IIF2B-1 | 1P | 9/3/71 |
| 990005640 | HICLE ACCIDENT PROCEDURES | APCI-IIF2C-1 | 1P | 8/22/71 |
| 990005650 | AND CONTROLLED SLOSHING | APCI-IIF2D-1 | 1P | 8/22/71 |
| 990005660 | TATION- LIST OF STANDARDS | APCI-IIF2E-1 | 1P | 8/22/71 |
| 990005610 | IGN CONCEPTS AND CRITERIA | APCI-IIF2-1 | 2P | 2/18/72 |
| 990005710 | S GAS-PRESSURE-REGULATORS | APCI-IIF3A-1 | 3P | 12/10/71 |
| 990005720 | IONS AND FAILURES VALVES | APCI-IIF3A(3)-1 | 1P | 12/30/71 |
| 990005730 | U PRESSURE), LINE-SURGES | APCI-IIF3B-1 | 1P | 2/18/72 |
| 990005740 | VIBRATIONS) DETERIORATION | APCI-IIF3C-1 | 1P | 12/30/71 |
| 990005670 | MAFUNCTION AND FAILURES | APCI-IIF3-1 | 1P | 11/12/71 |
| 990005680 | IPMENT OR INSTRUMENTATION | APCI-IIF3-2 | 2P | 2/4/72 |

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| 990005700 | RES COMPRESSORS AND PUMPS | APCI-IIF3-4 | 15P | 1/23/72 |
| 990005690 | TH OTHER OXYGEN-EQUIPMENT | APCI-IIF3-6 | 2P | 2/3/72 |
| 990005750 | RDS- FIRES AND EXPLOSIONS | APCI-IIIG-1 | 6P | 11/11/71 |
| 990005760 | ERE WHY AND HOW STRUCTURE | APCI-IIIAI-1 | 1P | 9/12/71 |
| 990005770 | N WHERE WHY AND HOW LEAKS | APCI-IIIAZ-1 | 1P | 9/12/71 |
| 990005780 | UMENTATION AND CONTROLS | APCI-IIIA3-1 | 1P | 9/12/71 |
| 990005790 | AND HOW INSULATION CHECK | APCI-IIIA4-1 | 1P | 9/12/71 |
| 990005800 | IUNS OF THE AGING SYSTEM | APCI-IIIA5-1 | 1P | 8/22/71 |
| 990005810 | IIVE MAINTENANCE PROGRAM | APCI-IIIA5-2 | 5P | 9/12/71 |
| 990005820 | S, TRAPS, AND INSTRUMENTS | APCI-IIIB-1 | 2P | 11/1/71 |
| 990005830 | PROGRAM PRESSURE TESTING | APCI-IIIC-1 | 3P | 9/12/71 |
| 990005850 | ING AND AREA PLACARDING | APCI-IIVA-1 | 4P | 11/5/71 |
| 990005860 | ERGENCIES WARNING DEVICES | APCI-IIVB-1 | 5P | 11/12/71 |
| 990005870 | CIES PROTECTION PERSONNEL | APCI-IIVC1-1 | 6P | 1/13/72 |
| 990005880 | CENT SYSTEMS PROTECTION | APCI-IIVC2-1 | 4P | 1/13/72 |
| 990005890 | CTION GENERAL PRECAUTIONS | APCI-IIVE-1 | 2P | 11/8/71 |
| 990005900 | RELATED TO OXYGEN-SAFETY | APCI-IIVE-2 | 1P | 2/21/72 |
| 990005840 | APCI SYSTEM-EMERGENCIES | APCI-IV-1 | 1P | 12/23/71 |
| 990001300 | -034 TO 61-40 AND 61-42 | APCI-IWG-NO-10-0589 | 1P | 2/3/61 |
| 990001210 | EN APPI-ANAL-REP-61-435 | APCI-IWO-NO-10-0858 | 1P | 6/6/61 |
| 990001340 | TEMPERATURES APPI-TR-53 | APCI-IWO-NO-10-1370 | 20P | 8/62 |
| 990001850 | WITH CARBON STEEL SPRING | APCI-IWO-NO-10-7071 | 20P | APCI-PROJECT-NO-00-5-3246-51.12.50 |
| 990001430 | NAL-REP-63-1662 AND 1663 | APCI-IWO-NO-69-1034 | 1P | 11/6/63 |
| 990001140 | ST APPI-ANAL-REP-61-683 | APCI-IWU-NO-80-0068 | 1P | 9/18/61 |
| 990001330 | TM APPI-ANAL-REP-60-496 | APCI-IWU-NO-81-0017 | 1P | 1/6/61 |
| 990001160 | APCI-ANAL-REP-60-495,61-3 | APCI-IWU-NO-81-0018 | 1P | 1/16/61 |
| 990001350 | OMPOUND SO-32 AND VITON A | APCI-IWU-NO-81-0095 | 1P | 4/27/66 |
| 990001410 | OC APPI-ANAL-REP-70-026 | APCI-IWU-NO-EA-7027 | 2P | 1/30/70 |
| 990002930 | EEN) FOAM-GLAS (CORNING) | APCI-IWO-NO-LA-0333 | APCI-MEMO-68 | 10/24/68 2P |
| 990001870 | YGEN-NITROGEN-ATMOSPHERES | APCI-IWU-NO-LB-G043 | APCI-TM-112 | 6P 5/8/68 |
| 990003050 | STYLE-NO-61 GARLOCK-900 | APCI-IWU-NO-LB-0795 | APCI-ANAL-REP-71-264 | 2P 5/28/71 |
| 990001420 | 70-014,70-015 APPI-123 | APCI-IWU-NO-XD0123 | 2P | 1/30/70 |
| 990003060 | E-O-RING (1/8-INCH DIA) | APCI-IWU-NO-XD-0128 | APCI-ANAL-REP-71-399 | 1P 8/17/71 |
| 990003120 | FROM CREST PRODUCTS CO | APCI-IWU-NO-XD-0134 | APCI-ANAL-REP-71-446 | 1P 10/25/71 |
| 990003420 | ITY LOX/LIN STORAGE TANK | APCI-JOB SPECIFICATION FOR | JOB-NO-00-2-2775 | APCI-NU-71-2775-16.10-1A 2P 9/16 |
| 990000590 | E LUBRICANTS, STEEL-PIPES | APCI-MAR-87-0-8820 | 1P | 4/61 |
| 990000570 | ERIMENTATION- TEFLON-HUSE | APCI-MAR-87-0-8820 | 1P | 5/60 |
| 990000580 | K-HOSES PLASITE-NO-7122H | APCI-MAR-87-0-8820 | 1P | 6/60 |
| 990000600 | ANE FOAM (EPON-FOAM-H-60) | APCI-MAR-87-0-8820 | 1P | 8/61 |
| 990000610 | LED-PLATE-251, PIPE-DOUPE | APCI-MAR-87-0-8820 | 1P | 9/61 |
| 990000640 | CYL-SEAL SEALING COMPOUND | APCI-MAR-87-0-8821 | 1P | 1/62 |
| 990000620 | LE WOOD, ACTIVATED CARBON | APCI-MAR-87-0-8821 | 1P | 12/61 |
| 990000630 | N, T-FILM-THREAD COMPOUND | APCI-MAR-87-0-8821 | 1P | 11/61 |
| 990000660 | ED ASBESTOS-ROPE MATERIAL | APCI-MAR-87-0-8821 | 1P | 2/62 |
| 990000670 | PREGNATED FIBERGLASS LAVA | APCI-MAR-87-0-8821 | 1P | 3/62 |
| 990000680 | -SPRAY-KOTE, AND DRI-LUBE | APCI-MAR-87-0-8821 | 1P | 4/62 |
| 990000690 | -FIBER-REINFORCED PLASTIC | APCI-MAR-87-0-8821 | 1P | 4/62 |
| 990000700 | UBSICANT, TARSET, PLASITE | APCI-MAR-87-0-8821 | 1P | 6/62 |
| 990000710 | OTE-TYPE-Z AND TYPE-X-15 | APCI-MAR-87-0-8821 | 1P | 7/62 |
| 990000720 | YMER, NYLON, CUTTING-OILS | APCI-MAR-87-0-8822 | 1P | 3/63 |
| 990000700 | LLULUBE-300 CELLULUBE-220 | APCI-MAR-87-0-8822 | 1P | 5/63 |
| 990000730 | LULUBE-300, CELLULUBE-220 | APCI-MAR-87-0-8822 | 1P | 7/63 |
| 990000750 | 0, TITANIUM-TETRACHLORIDE | APCI-MAR-87-0-8822 | 2P | 6/63 |
| | | APCI-MAR-87-0-8822 | 2P | 9/63 |

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| 990000740 L, TITANIUM-TETRACHLORIDE | APCI-MEMO-87-0-8822 | 3P | 8/63 | | |
| 990001450 ITY CONTROL OF ROCK WOOL | APCI-MEMO 2 HIMMELBERGER,F. | | | APCI | QUALITY CONTROL OF ROCK WOOL |
| 990001110 LEAD SEAL-NO-2-JOHN CRANE | APCI-MEMO-59 | 01/28/59 | 2P | | |
| 990001470 K WOOL BETHLEHEM-STEEL-CO | APCI-MEMO-59 | 11/12/59 | 2P | | |
| 990001450 ITY CONTROL OF ROCK WOOL | APCI-MEMO-59 | 11/6/59 | 2P | | |
| 990001120 FLAMMABILITY TEMPERATURE | APCI-MEMO-59 | 12/11/59 | 1P | | |
| 990001500 LA-SITE PROTECTIVE COATING | APCI-MEMO-60 | 06/9/60 | 2P | | |
| 990001440 ON COATED ASBESTOS-BLUE | APCI-MEMO-60 | 09/30/60 | 2P | PLUS | 1P ATTACHMENTS |
| 990001660 A FLOWING OXYGEN STREAM | APCI-MEMO-61 | 04/17/61 | 3P | PLUS | 7P ATTACHMENTS |
| 990002740 APCI-PROJECT-NO-87-0-8820 | APCI-MEMO-61 | 06/28/61 | 5P | | |
| 990002750 TAKEN ON PRESSURE-GAUGES | APCI-MEMO-61 | 08/2/61 | 4P | | |
| 990001000 ESTS OF T-FILM AND PENTON | APCI-MEMO-61 | 11/28/61 | 2P | | |
| 990001100 OXYGEN REGULATORS T-FILM | APCI-MEMO-61 | 11/30/61 | 1P | | |
| 990001070 AND OF METHYLENE-CHLORIDE | APCI-MEMO-61 | 12/11/61 | 2P | | |
| 990001360 APCI-PROJECT-NO-87-8-8821 | APCI-MEMO-62 | 01/31/62 | 5P | | |
| 990000890 CI STORAGE TANK CLEANING | APCI-MEMO-63 | 01/24/63 | 1P | | |
| 990001320 YGEN COMPATIBILITY- NYLON | APCI-MEMO-63 | 05/17/63 | 1P | | |
| 990001170 Y TEST ON MOLY-LUBE-NO-99 | APCI-MEMO-63 | 06/11/63 | 1P | | |
| 990001130 ARBON-TAPE, PERMACEL-TAPE | APCI-MEMO-63 | 07/30/63 | 1P | | |
| 990000940 EARNING FOR OXYGEN SERVICE | APCI-MEMO-63 | 08/5/63 | 2P | PLUS | 9P ATTACHMENTS |
| 990002610 MP EXPLOSION AIRCO-BUTLER | APCI-MEMO-63 | 10/21/63 | 1P | PLUS | 6P ATTACHMENTS |
| 990001190 THREAD SEALANT MOLYLUBE-N | APCI-MEMO-63 | 10/4/63 | 1P | | |
| 990002920 NT OF AIR-SYSTEMS UNARCO | APCI-MEMO-63 | 11/1/63 | 3P | | |
| 990000900 GE TANK-NG-8 SANTAL/SUSAWA | APCI-MEMO-64 | 03/11/64 | 1P | PLUS | 1P ATTACHMENT |
| 990002570 ECIALTY-GAS GAUGE-FAILURE | APCI-MEMO-64 | 04/13/64 | 4P | | |
| 990000920 PANY S LOX-TANK VAPORIZER | APCI-MEMO-64 | 04/9/64 | 1P | PLUS | 1P ATTACHMENT |
| 990002250 T-OPER-MAN-VOL-4-SECT-6.3 | APCI-MEMO-66 | 10/17/66 | 2P | PLUS | SCHEDULE FOR |
| 990002770 OK ACCIDENT- GRANITE/CITY | APCI-MEMO-67 | 12/15/67 | 1P | | |
| 990002780 T- GRANITE/CITY FACILITY | APCI-MEMO-67 | 12/15/67 | 1P | | |
| 990002640 OXYGEN PIPE-LINE FAILURE | APCI-MEMO-67 | 12/29/67 | 1P | | |
| 990002240 N QUALITY-CONTROL-SAMPLES | APCI-MEMO-68 | 05/17/68 | 1P | | |
| 990002200 OX-SPILL NCU CONSHOCKEN | APCI-MEMO-68 | 05/23/68 | 2P | | |
| 990002840 QUIPMENT FAILURE SHAKOPEE | APCI-MEMO-68 | 06/12/68 | 2P | | |
| 990003260 EMS FOR OPERATING-PLANTS | APCI-MEMO-68 | 06/25/68 | 2P | | |
| 990002810 -MISS ACCIDENT- CREIGHTON | APCI-MEMO-68 | 06/4/68 | 2P | | |
| 990002930 NCI APCI-IWO-NO-LA-0353 | APCI-MEMO-68 | 10/24/68 | 2P | | |
| 990002650 APCI LOX TRANSFER PUMPS | APCI-MEMO-68 | 12/30/68 | 2P | PLUS | 2P ATTACHMENTS |
| 990002660 LOX TRANSFER PUMP SCREENS | APCI-MEMO-69 | 01/24/69 | 2P | PLUS | 3P ATTACHMENTS |
| 990001380 APCI HALOCARBON-WAX-6-25 | APCI-MEMO-69 | 02/6/69 | 1P | | |
| 990002750 LOW-METER RING SEAL-FLUID | APCI-MEMO-70 | 02/27/70 | 1P | | |
| 990000910 TER, HAH. APCI LOX TANKS | APCI-MEMO-70 | 06/26/70 | 1P | | |
| 990002580 PUMP FIRES AND EXPLOSIONS | APCI-MEMO-70 | 06/26/70 | 3P | | |
| 990001460 RANSFER FLUORUGREEN-E-600 | APCI-MEMO-70 | 10/23/70 | 1P | | |
| 990002760 APCI NASH VACUUM PUMPS | APCI-MEMO-71 | 01/19/71 | 2P | | |
| 990003270 LOX-PUMP SAFETY-BARRIERS | APCI-MEMO-71 | 02/19/71 | 2P | | |
| 990002750 SS ACCIDENT- BURNS/HARBOR | APCI-MEMO-71 | 02/8/71 | 2P | | |
| 990002480 LATHROP AUTO-LOAD SYSTEM | APCI-MEMO-71 | 03/22/71 | 2P | PLUS | 3P ATTACHMENTS |
| 990003240 ARING PROTECTION PROGRAM | APCI-MEMO-71 | 04/7/71 | 2P | PLUS | 1P ATTACHMENT |
| 990002490 APCI AUTO LOAD SYSTEMS | APCI-MEMO-71 | 05/4/71 | 2P | PLUS | 3P ATTACHMENTS |
| 990002170 AFETY REVIEW CHECK-LIST | APCI-MEMO-71 | 05/4/71 | 3P | | |
| 990003140 REC LOX TANKERS BY AMETEK | APCI-MEMO-71 | 06/22/71 | 1P | | |
| 990003100 SHEET PACKING STYLE-61 | APCI-MEMO-71 | 06/27/71 | 1P | PLUS | 2P ATTACHMENTS |
| 990003070 Y-MEMORIAL-HOSPITAL 5/70 | APCI-MEMO-71 | 06/3/71 | 17P | | |
| 990002220 A AND CLASS-AAA CLEANING | APCI-MEMO-71 | 07/22/71 | 1P | | |

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| 990002210 | CLEANLINESS REQUIREMENTS | APCI-MEMO-71 | 07/22/71 | 2P |
| 990002910 | XYGEN COMPRESSOR SUCTION | APCI-MEMO-71 | 07/26/71 | 2P |
| 990003400 | UDY PROJECT 00-1-2495.07 | APCI-MEMO-71 | 12/10/71 | 1P |
| 990002670 | COSMODYNE LOX-PUMP SAFETY | APCI-MEMO-71 | 1/01/26/71 | 2P |
| 990002680 | D. APCI LOX-PUMP SAFETY | APCI-MEMO-71 | 2/19/71 | 1P |
| 990003420 | ION FOR JOB-NO-00-2-2775 | APCI-NO-71-2775-16.10-1A | 2P | 9/16/71 |
| 990002700 | OF REGULATORS AND TORCHES | APCI-PAPER | 17P PLUS 2P ATTACHMENTS | 7/65 |
| 990002510 | VE TO LIQUID-VAPOR-CLOUDS | APCI-PAPER | 7P | 1971 |
| 990001040 | ION-EQUIPMENT MAINTENANCE | APCI-POM-1.12 | 7P | 4/21/67 |
| 990002020 | CATROL PROCEDURE- TAG OUT | APCI-POM-SEC-1.03 | 2P PLUS EXHIBIT-A | 1P 2/15/67 |
| 990002030 | EDURE- SAFETY WORK-PERMIT | APCI-POM-SEC-1.04 | 3P PLUS EXHIBIT-A | 1P 2/16/67 |
| 990000990 | T SOLVENT WASHOUT-GENERAL | APCI-POM-SEC-1.05 | 12P | 2/20/67 |
| 990002860 | FOR ANALYTICAL PURPOSES | APCI-POM-SEC-1.07 | 5P | 7/7/70 |
| 990000950 | NTS AND IN OXYGEN SERVICE | APCI-POM-SEC-1.08 | 7P PLUS 3P ATTACHMENTS | 4/4/67 |
| 990003310 | RTABLE FIRE-EXTINGUISHERS | APCI-POM-SEC-1.13 | 5P | 3/30/67 |
| 990002270 | APCI COLD-BOX LEAKS | APCI-POM-SEC-1.14 | 5P | 10/30/68 |
| 990002830 | AND ASSOCIATED EQUIPMENT | APCI-POM-SEC-1.17 | 8P | 4/23/69 |
| 990002380 | ACITY OR LARGER) GENERAL | APCI-POM-SEC-2.02 | 7P PLUS EXHIBITS ABCDEFG | 8/29/69 |
| 990000980 | LVENT WASHOUT-FREQUENCIES | APCI-POM-SEC-5.07 | 3P | 7/15/70 |
| 990002530 | INDUSTRIAL SAFETY POLICY | APCI-POM-SEC-5.16 | 7P | 10/30/68 |
| 990002330 | SAFETY REPORTS AND FORMS | APCI-POM-SEC-5.18 | 6P PLUS EXHIBITS ABCDEFGH | 3/3/70 |
| 990002550 | APCI ACCIDENT REPORTING | APCI-POM-SEC-5.21 | 4P PLUS APPENDIX-A EXHIBIT-A | 5/8/68 |
| 990002300 | -VALVES AND RUPTURE-DISCS | APCI-POM-SEC-6.02 | 19P INCLUDING EXHIBITS ABCDE | 12/8/64 |
| 990002290 | ON PREVENTIVE MAINTENANCE | APCI-POM-SEC-6.05 | 5P | 10/30/68 |
| 990002040 | PCI CODED VESSEL REPAIRS | APCI-POM-SEC-6.09 | 4P | 11/29/68 FOR ATTCHMTS SEE 205 206 207 |
| 990002280 | PCI CODED VESSEL REPAIRS | APCI-POM-SEC-6.09 | 4P | 15P OF ATTCHMTS 11/29/68 |
| 990002050 | TH MARYLAND CASUALTY CO | APCI-POM-SEC-6.09-ATTCHMT-1 | 2P | 8/27/69 |
| 990001850 | ING APCI-INO-NO-10-7071 | APCI-PROJECT-NO-00-5-3246-51.12.50 | APCI-TM-079 | 3P 4/27/65 |
| 990001880 | IN AN OXYGEN-ATMOSPHERE | APCI-PROJECT-NO-00-7-3480-51.00 | APCI-TM-114 | 5P 6/24/68 |
| 990002740 | SURE-GAGES SAFETY DEVICES | APCI-PROJECT-NO-87-0-8820 | APCI-MEMO-61 | 06/28/61 5P |
| 990001090 | OF STANDARD IGNITION TEST | APCI-PROJECT-NO-87-0-8820/1 | 8P | 11/17/61 |
| 990001360 | TETRACHLORIDE- CHLOROFORM | APCI-PROJECT-NO-87-8-8821 | APCI-MEMO-62 | 01/3/62 5P |
| 990000770 | S FOR AIR-PLANT EQUIPMENT | APCI-QUAL-CONT-LAYOUT-101F | 2P PLUS 5P OF ATTCHMTS | 7/1/71 |
| 990000780 | S USED FOR OXYGEN SERVICE | APCI-QUAL-CONT-LAYOUT-102F | 3P | 7/1/71 |
| 990001310 | U MINERAL WOOL INSULATION | APCI-QUAL-CONT-LAYOUT-103L | 2P | 7/1/71 |
| 990002850 | MANUFACTURING FACILITIES | APCI-QUAL-CONT-LAYOUT-103F | 11P | REV 12/14/65 |
| 990000790 | CLEANLINESS REQUIREMENTS | APCI-QUAL-CONT-LAYOUT-104F | 1P | 7/1/71 |
| 990002070 | PNEUMATIC TESTING-GENERAL | APCI-QUAL-CONT-LAYOUT-105A | 3P | 7/1/71 |
| 990000800 | CLEANLINESS REQUIREMENTS | APCI-QUAL-CONT-LAYOUT-105F | 3P | 7/1/71 |
| 990000810 | CLEANLINESS REQUIREMENTS | APCI-QUAL-CONT-LAYOUT-106F | 3P | 7/1/71 |
| 990000820 | CLEANLINESS REQUIREMENTS | APCI-QUAL-CONT-LAYOUT-107F | 3P | 7/1/71 |
| 990000830 | R VENDOR CLASS-B CLEANING | APCI-QUAL-CONT-LAYOUT-114F | 2P | 7/1/71 |
| 990000840 | R VENDOR CLASS-A CLEANING | APCI-QUAL-CONT-LAYOUT-115F | 2P | 7/1/71 |
| 990000850 | VENDOR CLASS-AA CLEANING | APCI-QUAL-CONT-LAYOUT-116F | 2P | 7/1/71 |
| 990002060 | ORUSTATIC TESTING-GENERAL | APCI-QUAL-CONT-LAYOUT-117A | 2P | 7/1/71 |
| 990000860 | VENDOR CLASS-AAA CLEANING | APCI-QUAL-CONT-LAYOUT-117F | 3P | 7/1/71 |
| 990000870 | GER CLEANING REQUIREMENTS | APCI-QUAL-CONT-LAYOUT-119F | 2P | 7/1/71 |
| 990000880 | SPECIFIED PAINT SYSTEMS | APCI-QUAL-CONT-LAYOUT-120F | 3P | 7/1/71 |
| 990001490 | PITTSBURGH CHEMICAL CO | APCI-R+D-NOTEBOOK-111 | P129-32 | 4P 7/62 |
| 990001370 | NO- RTV-60-NP-134372-M235 | APCI-R+D-NOTEBOOK-111 | P149 | 1P 1/63 |
| 990001220 | WITH HIGH-PRESSURE OXYGEN | APCI-R+D-NOTEBOOK-111 | P152 | 1P 1/63 |
| 990001480 | APCI PIPE BURNING TESTS | APCI-R+D-NOTEBOOK-111 | P26-9 | 4P 4/17/61 |
| 990001200 | BE-KOTE-AR AND HOLYLUBE-N | APCI-R+D-NOTEBOOK-130 | P16-7 | 2P 2/11/63 |
| 990001230 | WITH HIGH-PRESSURE OXYGEN | APCI-R+D-NOTEBOOK-130 | P3 | 1P 6/63 |

990003580 AIR-SEPARATION PLANT
 990003590 OPERATIONS SAFETY MANUAL
 990003600 AVE ANOTHER PAIR OF EYES
 990003610 OXYGEN COMPRESSOR FIRE
 990003620 A CYLINDER INTO A ROCKET
 990003630 APCI FIRE IN OXYGEN-LINE
 990003640 LIQUID OXYGEN LOADING
 990003650 BELLS IN CRYOGENIC SERVICE
 990003660 APCI WEAR SAFETY SHOES
 990003670 OXYGEN CYLINDER FAILURE
 990003680 Y CAUSED HIGHWAY ACCIDENT
 990003690 OLATION OF PIPING-SYSTEMS
 990003700 W. APCI GASEOUS OXYGEN
 990003710 PCI DRAIN-LINE EXPLOSION
 990003720 POUNDS FOR OXYGEN-SYSTEMS
 990003730 NTH THE COST AND EFFORT
 990003740 YLINDERS BEFORE REFILLING
 990003750 PCI VACUUM PUMP FAILURES
 990003760 PRESSURE GAUGE FAILURES
 990003770 CYLINDERS HAS ITS HAZARDS
 990003780 h.w. APCI HUMAN TORCHES
 990003790 h.w. APCI LIQUID OXYGEN
 990003800 C THEN THERE WAS DARKNESS
 990003810 S IN THE WELDING INDUSTRY
 990003820 PCI CARBON-TETRACHLORIDE
 990003830 CRITERIA- AIR-SEPARATION
 990003840 K-SEPARATION PLANT-LAYOUT
 990003850 AND SAFETY-RELIEF DEVICES
 990003860 ENIC-LIQUID, AND DISPOSAL
 990003870 ATION, OXYGEN, COMPRESSOR
 990003880 NT COMPONENTS- COLD-BOXES
 990003890 EM, AND CRYOGENIC-LIQUIDS
 990003900 EMS, AND COMPRESSED-GASES
 990003910 ERIALS AND OXYGEN SERVICE
 990003920 YGEN COMPATIBLE MATERIALS
 990003930 AIR-SEPARATION PLANT-SITE
 990003940 EPARATION-PLANT OPERATION
 990003950 INDUSTRIAL SAFETY POLICY
 990003960 SAFETY- OCCUPATIONAL NOISE
 990003970 EDURES- TAG OUT PROCEDURE
 990003980 ANT SAFETY WORK PERMITS
 990003990 RES- EMERGENCY PROCEDURES
 990004000 OCEDES-PURGING METHODS
 990004010 KY PROTECTIVE EQUIPMENT
 990004020 KING APPAREL HARD HATS
 990004030 QUIPMENT- EYE PROTECTION
 990004040 HEAT PROTECTIVE CLOTHING
 990004050 E EQUIPMENT
 990004060 AGE AIR-SEPARATION PLANT
 990004070 ANING FOR OXYGEN SERVICE
 990004080 ENT- OUTSIDE FIRE-HYDRANT
 990004090 DRANT-HOUSE AND EQUIPMENT
 990004100 AND LUX LOADING FACILITY

APCI-REPORT P86 2/28/64 88P 1964 (OUT OF PRINT)
 APCI-SAFETY MANUAL-20P64 1P 6/1/61
 APCI-SAFETY-GRAM-NO-01 2P 7/7/61
 APCI-SAFETY-GRAM-NO-03 1P 8/7/61
 APCI-SAFETY-GRAM-NO-04C 1P 10/20/61
 APCI-SAFETY-GRAM-NO-05 1P 11/17/61
 APCI-SAFETY-GRAM-NO-06 1P 10/25/63
 APCI-SAFETY-GRAM-NO-10-REV-1 1P 5/14/62
 APCI-SAFETY-GRAM-NO-11 2P 6/1/62
 APCI-SAFETY-GRAM-NO-13 2P 8/10/62
 APCI-SAFETY-GRAM-NO-17 1P 10/29/62
 APCI-SAFETY-GRAM-NO-21 6P 1/10/63
 APCI-SAFETY-GRAM-NO-23C 2P 1/17/63
 APCI-SAFETY-GRAM-NO-24 5P 3/22/63
 APCI-SAFETY-GRAM-NO-27 1P 8/1/63
 APCI-SAFETY-GRAM-NO-29 1P 8/9/63
 APCI-SAFETY-GRAM-NO-30 2P 8/21/63
 APCI-SAFETY-GRAM-NO-31 2P 10/4/63
 APCI-SAFETY-GRAM-NO-35 2P 5/8/64
 APCI-SAFETY-GRAM-NO-43 2P 3/26/65
 APCI-SAFETY-GRAM-NO-49 1P 1/3/66
 APCI-SAFETY-GRAM-NO-50C 6P 1/31/67
 APCI-SAFETY-GRAM-NO-54C 1P 3/15/67
 APCI-SAFETY-GRAM-NO-58 5P 11/26/67
 APCI-SAFETY-GRAM-NO-60C 1P 2/21/69
 APCI-SAFETY-STD-605.1 9P 11/10/60
 APCI-SAFETY-STD-605.1.3 6P 1/6/61
 APCI-SAFETY-STD-607.1.1.2 14P 10/6/62
 APCI-SAFETY-STD-607.1.2.3 3P 4/6/62
 APCI-SAFETY-STD-607.1.2.3 6P 12/7/62
 APCI-SAFETY-STD-607.1.5 7P 1/63
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 APCI-SAFETY-STD-608.1 7P 10/65
 APCI-SAFETY-STD-609.1 8P 6/65
 APCI-SAFETY-STD-610.1.1 5P 11/28/60
 APCI-SAFETY-STD-610.1/5 17P 2/16/61
 APCI-SAFETY-STD-625.0.1 13P 10/3/61
 APCI-SAFETY-STD-625.0.1.2 3P 4/9/71
 APCI-SAFETY-STD-626.3.3 2P 5/62
 APCI-SAFETY-STD-626.3.5 3P 6/19/61
 APCI-SAFETY-STD-626.3.8 8P 5/62
 APCI-SAFETY-STD-626.4.1 7P 1/70
 APCI-SAFETY-STD-627.3 14P 1/64
 APCI-SAFETY-STD-627.4.1 1P 6/15/70
 APCI-SAFETY-STD-627.4.2 5P 10/62
 APCI-SAFETY-STD-627.4.7 2P 5/68
 APCI-SAFETY-STD-627.4.8 1P 9/59
 APCI-SAFETY-STD-627.5.1 4P 6/15/70
 APCI-SAFETY-STD-629.0.10 1P 6/19/61
 APCI-SAFETY-STD-630.2.2 1P 7/26/61
 APCI-SAFETY-STD-630.2.3 3P REV-6/15/70
 APCI-SAFETY-STD-630.2.6 3P 1/64

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| 990002460 | EQUIPMENT- INSIDE- OUTSIDE | APCI-SAFETY-STD-630.3.2 | 3P | 5/68 |
| 990001940 | AND UNLOADING OPERATIONS | APCI-SAFETY-STD-635.19 | 6P | 2/68 |
| 990001970 | FIRE EXTINGUISHMENT | APCI-SAFETY-STD-639.30 | 5P | 2/68 |
| 990000380 | AIR-SEPARATION COLD-BOXES | APCI-IB-39 | 1P | 6/14/71 |
| 990003280 | IELDS FOR OXYGEN SYSTEMS | APCI-IB-42 | 3P | 9/30/71 |
| 990002870 | ES 1200-SERIES REGULATORS | APCI-TEST-PROCEDURE | 4P | 1/30/70 |
| 990001400 | OBILE-DTE-105-HYDROCARBON | APCI-IM-040 | 7P | 9/18/59 |
| 990001850 | ECT-NO-00-5-3246-51.12.50 | APCI-IM-079 | 3P | 4/27/65 |
| 990001870 | RES APCI-LWD-NO-LB-0043 | APCI-IM-112 | 6P | 5/8/68 |
| 990001880 | JECT-NO-00-7-3480-51.00 | APCI-IM-114 | 5P | 6/24/68 |
| 990005950 | RES 180 TO 100-PERCENT | APCI-IM-186 | 44P | 3/72 |
| 990001340 | ID-NITROGEN TEMPERATURES | APCI-TR-53 | APCI-LWD-NO-10-1370 | 20P 8/62 |
| 990005910 | VING SPILLS AND LEAKAGE | APCI-V-1 | 1P | 8/22/71 |
| 990005920 | EQUIPMENT AND PROPERTY | APCI-V-2 | 26P | 2/4/72 |
| 990005930 | CIDENTS INVOLVING OXYGEN | APCI-V-3 | 2P | 2/21/72 |
| 990005940 | R AIR-SEPARATION PLANTS | APCI-V-4 | 2P | 5/12/72 |
| 990003430 | W-PRESSURE STORAGE TANKS | API STANDARD-620 | 2/70 | |
| 990004180 | APL OVERHAUL PROCEDURE | APL-C-155/9.5 | 33P | 1971 |
| 990003610 | ESTS FOR CLASS-A CLEANING | APL-ENGR-SPEC-A.02 | 3P | 5/12/69 |
| 990003620 | EANLINESS (OXYGEN-CLEAN) | APL-ENGR-SPEC-A.03 | 4P | 4/1/71 |
| 990003600 | T FOR CLASS-B CLEANLINESS | APL-ENGR-SPEC-A.01 | 2P | 5/12/69 |
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| 1. Report No. NASA CR-120922 Vol. I | | 2. Government Accession No. | | 3. Recipient's Catalog No. | |
| 4. Title and Subtitle Liquid and Gaseous Oxygen Safety Review Final Report, Vol. I to IV (1320 pages - Total) | | | | 5. Report Date June 1972 | |
| | | | | 6. Performing Organization Code | |
| 7. Author(s) Abraham Lapin | | | | 8. Performing Organization Report No. APCI TM 184 | |
| 9. Performing Organization Name and Address Air Products and Chemicals, Inc. P. O. Box 538 Allentown, Pennsylvania | | | | 10. Work Unit No. | |
| | | | | 11. Contract or Grant No. NASA NO. NAS3-15083 | |
| 12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546 | | | | 13. Type of Report and Period Covered Contractor Report April 1971 - June 1972 | |
| | | | | 14. Sponsoring Agency Code | |
| 15. Supplementary Notes Project Manager, Paul M. Ordin Aerospace Safety Research and Data Institute Lewis Research Center Cleveland, Ohio | | | | | |
| 16. Abstract A thorough and detailed study of Air Products and Chemicals, Inc. and Air Products Ltd. practices in the design and use of equipment in oxygen service, was performed. The report includes Liquid and Gaseous Oxygen Safety Review information covering: Material Compatibility, Operational Hazards, Maintenance Programs, Systems Emergencies, and Accident/Incident Investigations and Reports, and a set of references. Areas requiring further research and development for systems involving exposure to oxygen environment have been identified. An index to the Liquid and Gaseous Safety Review Data Forms and a General Index have been included to allow for easy retrieval of the reported information. | | | | | |
| 17. Key Words (Suggested by Author(s)) Liquid and Gaseous Oxygen Safety Review, Material Compatibility, Compatibility Checks, Operational Hazards, Maintenance Programs, Systems Emergencies, Accident and Incident Investigations and Reports, Transportation Systems, Storage Systems. | | | 18. Distribution Statement Unclassified Unlimited | | |
| 19. Security Classif. (of this report) Unclassified | | 20. Security Classif. (of this page) Unclassified | | 21. No. of Pages Vol. I - 270 pgs. | 22. Price* \$3.00 Vol. I only |

* For sale by the National Technical Information Service, Springfield, Virginia 22151
\$21.00 for all four volumes.