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Date of request 6/28/96 Expected receipt of document 1/8/95

Document number none KP-3219 Date of document ~1962

Title and author (if document is unnumbered)

Metal Finishing ORGDP

(This section to be completed by Document Center)

Date request received 7/1/96

Date submitted to ADC 7/11/96

Date submitted to HSA Coordinator 7/1/96

(This section to be completed by HSA Coordinator)

Date submitted to CICO 7/11/96

Date received from CICO 7/16/96

Date submitted to ChemRisk/Shonka and DOE 8/1/96

(This section to be completed by ChemRisk/Shonka Research Associates, Inc.)

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#3295

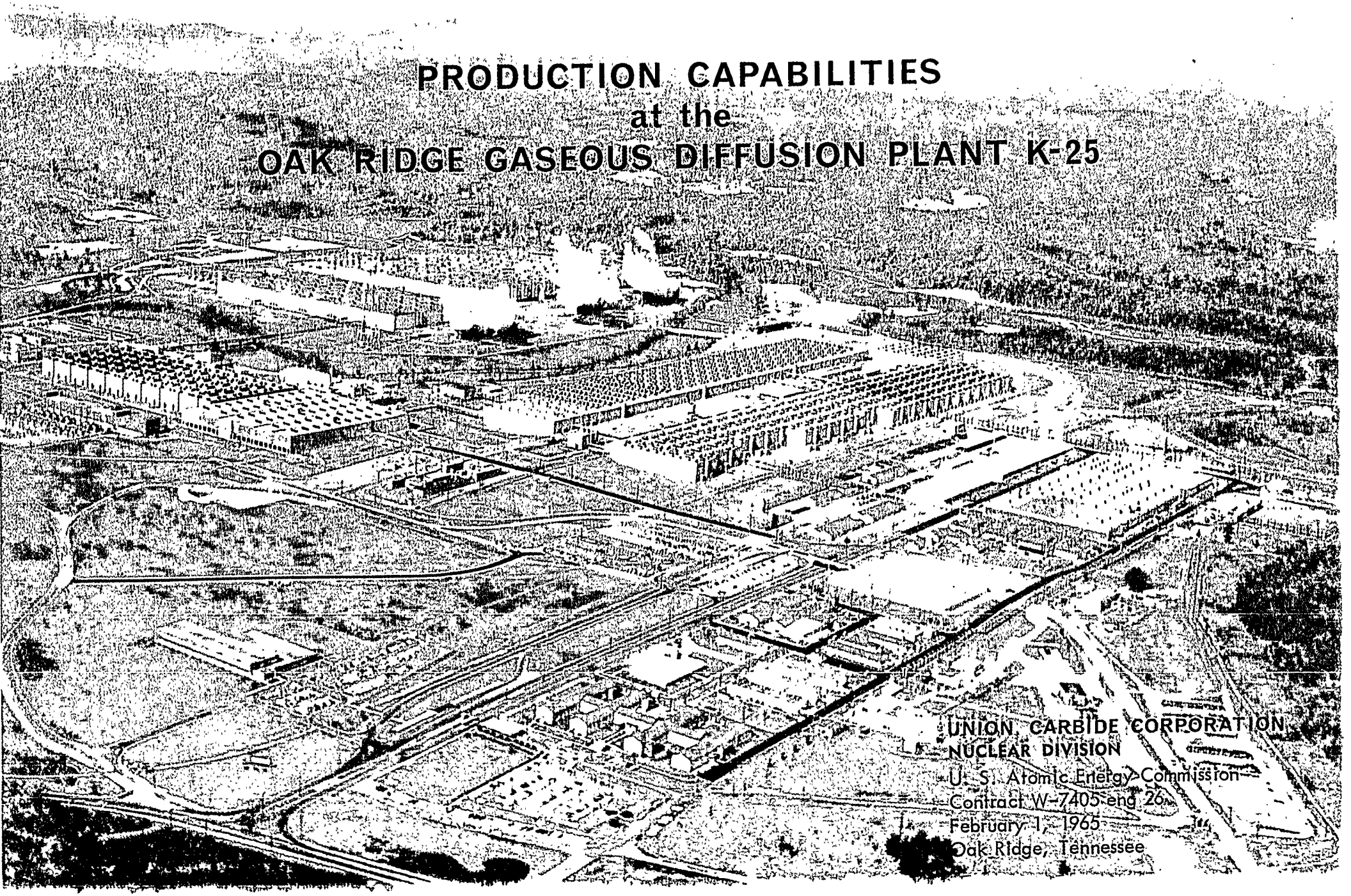
METAL FINISHING

OAK RIDGE GASEOUS DIFFUSION PLANT
K-25

This document has been approved for release to the public by: T W Selley for S S Quist/BST 7/16/96
Technical Information Officer Date
Oak Ridge K-25 Site

KP-3217

PRODUCTION CAPABILITIES
at the
OAK RIDGE GASEOUS DIFFUSION PLANT K-25



UNION CARBIDE CORPORATION
NUCLEAR DIVISION
U. S. Atomic Energy Commission
Contract W-7405-eng 26
February 1, 1965
Oak Ridge, Tennessee

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
P. O. BOX P, OAK RIDGE, TENNESSEE 37831

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The attached brochure, "Metal Finishing," (K-P-3217) has been compiled for the purpose of describing special facilities and capabilities available at the Oak Ridge Gaseous Diffusion Plant to Government agencies and others who might have need to utilize them.

Should you desire further information relative to any of the items outlined in this brochure, we shall be glad to provide it upon request.

R. G. Jordan, Superintendent
Oak Ridge Gaseous Diffusion Plant

INTRODUCTION

The unique requirements for corrosion resistance at the Oak Ridge Gaseous Diffusion Plant have contributed to the development of metal plating for equipment on a massive scale. The technology, production capabilities, and facilities for such activities at this plant have expanded and become more diversified, consistent with the varied requirements of production and research. The principal plating is nickel, and both the electroless and electrolytic processes are used on a large and small scale. The electroless coating is used where uniformity of coat, coverage of unusual shapes, or low coefficient of friction is desired. The electrolytic process is used when relatively simple nickel plated parts are to be constructed, by welding, into a larger component, or when special tensile strength may be demanded of the coating.

A variety of other metal finishing techniques has evolved from the special needs at the Oak Ridge Gaseous Diffusion Plant. The removal of uranium-bearing deposits led to liquid honing and vapor blasting methods, now applicable in the cleaning and custom-finishing of a variety of metal surfaces. Other requirements have led to capabilities in anodizing and alodining of aluminum and magnesium, electropolishing, and special coatings for carbon and stainless steels. The production facilities are supported by research and development laboratories which render prompt attention to unusual problems and maintain an active program directed toward meeting new requirements in the field of metal finishing.

This brochure has been prepared to acquaint other government agencies with these unique capabilities, facilities, specialized skills, and unusual materials. By this means it will be possible to effect economies through interagency exchange of services and materials not adequately available from private sources. This information will also be of assistance in acquainting private industry with these new developments, innovations, and unusual materials which have resulted from U. S. Atomic Energy Commission sponsored programs. It is not intended that plant facilities will be used in competition with private industry but rather that, consistent with Government policies in this regard, fullest use of existing Government property be made in satisfying the Government's own requirements.

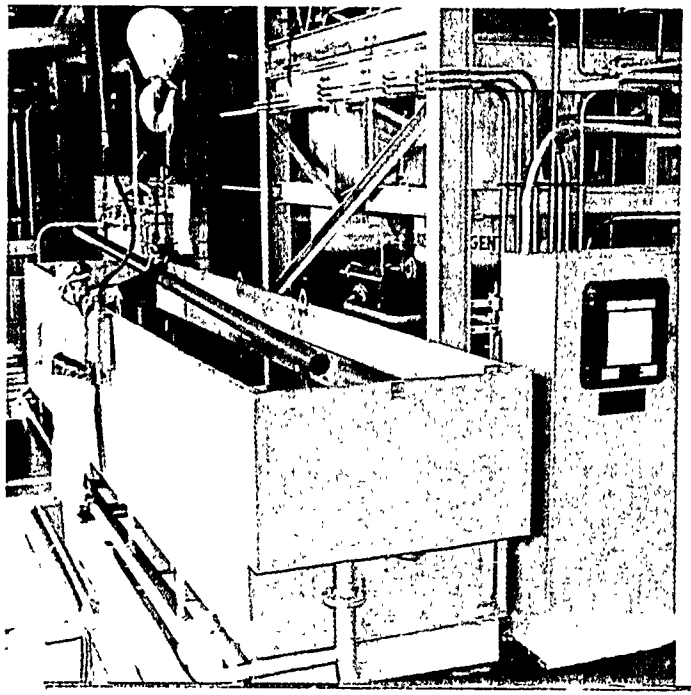
Further information may be obtained by contacting the ORGDP Special Projects Department, telephone 615-483-8611, Ext. 3-3233, or your FTS Access Code, 615-483-3233.

ELECTROLESS NICKEL PLATING

This plating facility consists of plating tanks, heat exchangers, pumps, reagent addition system, and heat treatment furnaces. The largest tank, 34' x 6' x 8', has a capacity of about 11,000 gallons. With proper jigging, the inside surfaces of tanks, heat exchanges, pump casings, and similar vessels and equipment are nickel coated with ease.

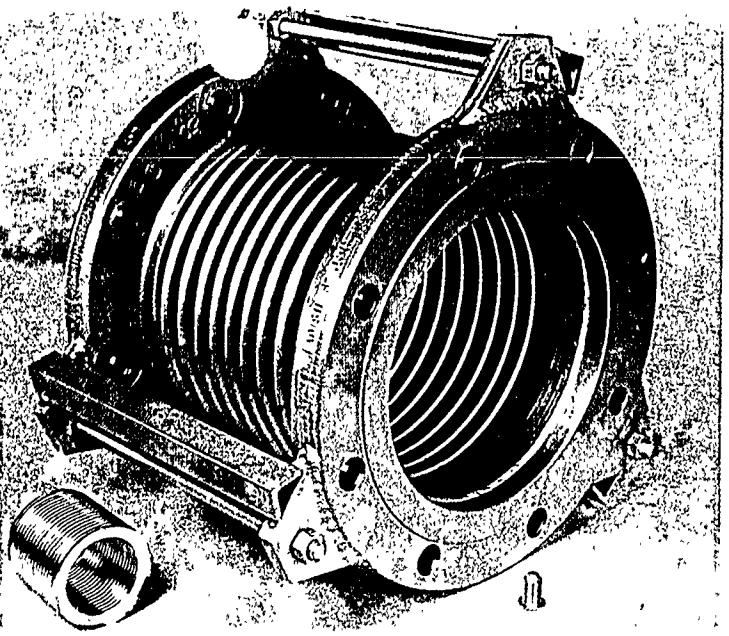
Associated equipment includes appropriate cleaning tanks capable of handling a wide variety of chemical cleaning or pickling agents for immersion cleaning of many different metals and alloys prior to plating.

The heat treating unit includes a large furnace and a gas cracker to provide an inert atmosphere during treatment. The temperature of this furnace can be varied to obtain the desired plate hardness. In addition, a vacuum furnace, recently added for heat treatment of nickel plated uranium components, provides a seven cubic foot capacity for general vacuum application.



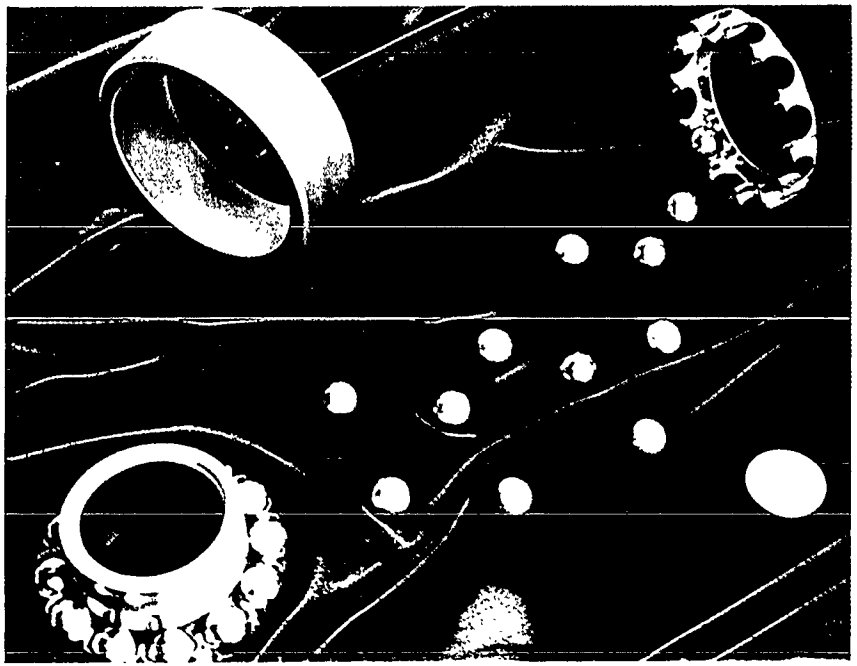
Testing facilities encompass inspection for adherence, porosity, plate thickness, and surface smoothness. Plating thickness on steel is measured up to 0.1", using a magnetic field instrument (Permascope), to an accuracy of .0001". Plating thickness measuring range and accuracy for other substrate materials varies with the material.

ELECTROLESS NICKEL PLATING TANK - Twenty-foot section of pipe plated with .001" ± .0001" of electroless nickel to withstand corrosion. Recent activities include the coating of components associated with a "Zero Gravity Research Facility" for another government agency. The largest component is 32' long and weighs over twelve tons.



BELLOWS - Outstanding coating uniformity in all corrugations of various sizes, with no distortion. A wide variety of components of intricate configuration and complex geometry have been successfully electroless nickel plated to avoid buildup on points, edges, and corners.

BEARINGS - Steel bearing and race of vane assembly for 30-inch control valve plated with electroless nickel and heat treated to provide accurate control of dimensions, lubricity, wear resistance, and hardness. Resistance to highly corrosive chemicals is also provided on all surfaces.



ANODIZING & LIQUID HONING

ELECTRO PLATING

ELECTROLESS PLATING

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ELECTRO PLATING

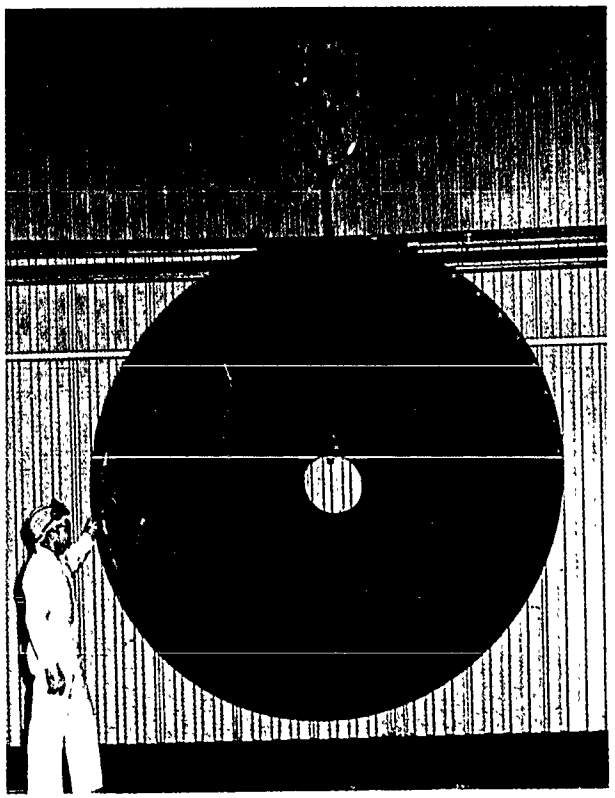
Considerable advances in the electroplating industry have been accomplished in the past few years. The rapid increase in the large scale application of plating has resulted in many additional uses of electroplated materials.

One production facility at the diffusion plant is equipped with seven processing tanks, each 7' x 15' x 15' deep. The tanks, including the plating tank, each have a liquid volume of 9,500 gallons. This facility is capable of processing material up to 11 feet in diameter.

The plating bath is a conventional type Watts bath with slight modifications to achieve the needs for the various plating applications. To meet the plating requirements, the system has been adapted for use of soluble or insoluble anode type operation, with diversified handling and precise control facilities.

Testing facilities include examination of adherence, porosity, plate thickness, and surface smoothness. Plating thickness on steel is measured up to .005", using an eddy current instrument (Dermitron), to an accuracy of .0002". The measuring range and accuracy of plating thickness on other base materials varies with the material.

The compressor shaft shown on the left is approximately 10 feet long. These shafts are components of equipment used in the gaseous diffusion plants and are under constant exposure to very corrosive gases. Electroplating of this type shaft furnishes protection from corrosion and requires a plate that is malleable and of excellent adhesion in order to permit machining and balancing. Operating conditions require it to rotate within ± .0025" of the true horizontal axis when in service.



STEEL DISC - This 11' diameter disc is an important component of equipment used in gaseous diffusion systems. Continuously exposed to an atmosphere of corrosive uranium hexafluoride gas, these discs require a malleable uniform plate of nickel. This requirement presents an unusual control demand, which is routinely achieved.

ANODIZING & LIQUID HONING

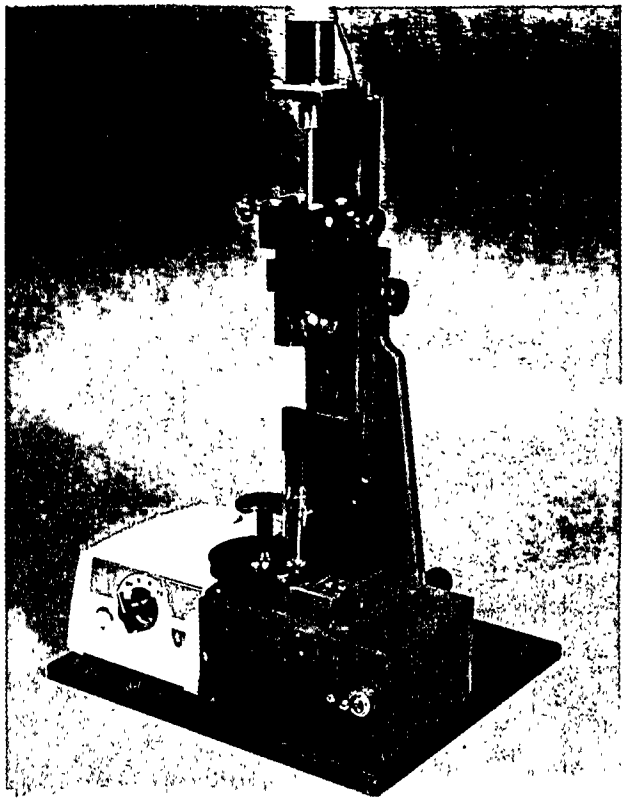
ELECTRO PLATING

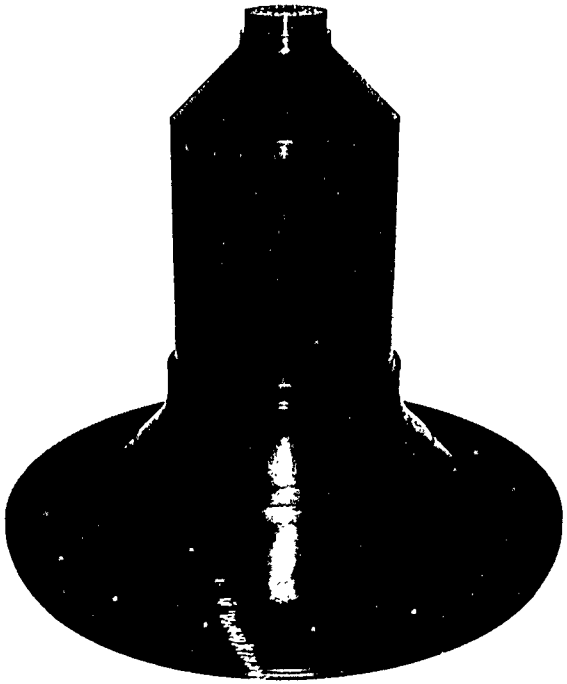
ANODIZING

Two individual anodizing processes - Type 1, using 10% chromic acid, and Type 2, using 18% sulfuric acid - are used to electrochemically deposit uniform coatings of aluminum oxide on wrought aluminum alloys 1100, 3003, 2024, 5052, 6061, and 7075.

Single color and multiple color combinations are available with a bright or matte finish to meet Federal Color Specification 595.

Each anodizing tank is 8' x 5' x 6'. Associated equipment includes a refrigeration system with cleaning and rinsing tanks. For sealing, a 6' x 4' x 5' tank is used to enhance the corrosion resistance of the oxide coating. Control of the current density is accomplished using silicon diode rectifiers.



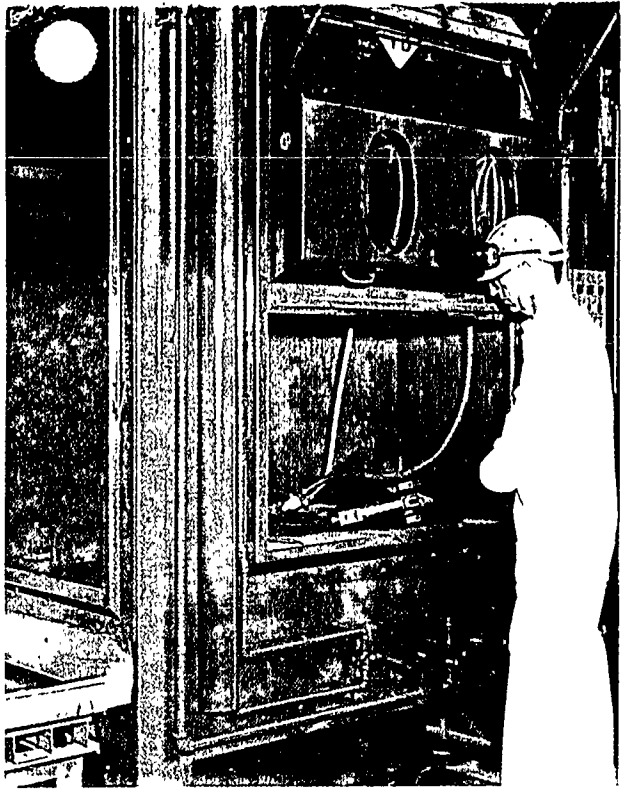


BAND RECOVERY APPARATUS - Type 6061 aluminum, anodized with the sulfuric acid process and dyed for decorative appearance. The instrument, fabricated and anodized for another government agency, provides a system for withdrawing thin layers of materials from density gradients in ultracentrifuge rotors. Similar units have been coated and dyed blue, red, and yellow.

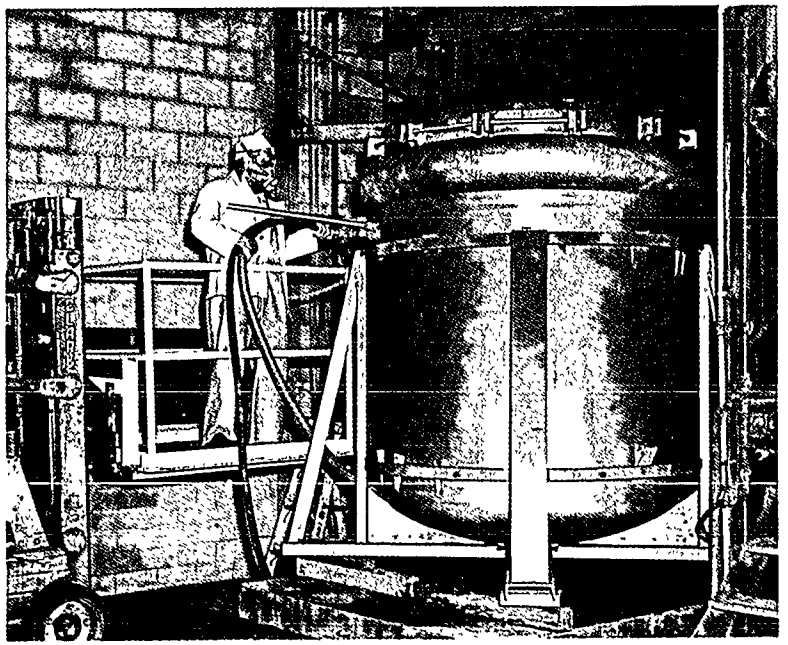
DE-SPIN HUB - Galvanic coating on magnesium-thorium de-spin table hub for corrosion protection with overall dimensions held to .0002". Several of these hubs, machined and anodized at ORGDP, connect the second and third stages of rockets used to study liquid fuel under weightless conditions.

LIQUID HONING

The liquid honing system, employing an abrasive slurry at high velocity, is used to "metallurgically clean" components prior to electropolishing, electrolytic and electroless plating, and special coating processes. Controlled microscopically pitted surfaces to retain lubricant uniformly can be achieved, as well as decorative matte surface finishes. This particular process can also successfully remove (1) fine and coarse burrs, (2) microscopic fuzz from cutting edges of tools, and (3) machining or directional polish lines and marks from objects such as molds, dies, etc., fabricated of metal, plastic, and rubber. The liquid honing facilities are used to accommodate an extremely wide range of equipment size.

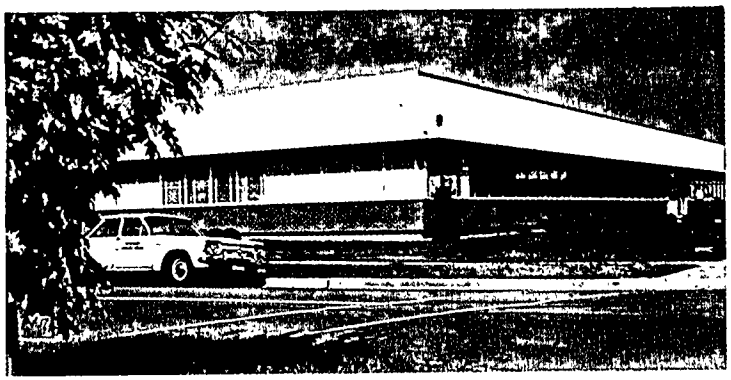


NUCLEAR SAFE LIQUID HONING - The operator on the right is setting up to liquid hone a fuel-charging ram associated with an Experimental Gas Cooled Reactor. Numerous components of minute and intricate configuration requiring close finishes have been cleaned with complete success. This particular machine is also unique due to a special "nuclearly safe" slurry storage slab and is used to hone components contaminated with uranium of any degree of isotopic enrichment.



LARGE EQUIPMENT LIQUID HONING - A system for liquid honing to "metallurgically clean" a Molten Salt Reactor Vessel. Removal of scale from the welds facilitates the dye penetrant inspection test. The operation shown removes contaminants such as uranium, thorium, silver, mercury, lead, copper, chlorine, and graphite from components associated with the High Flux Isotope Reactor, Oak Ridge National Laboratory.

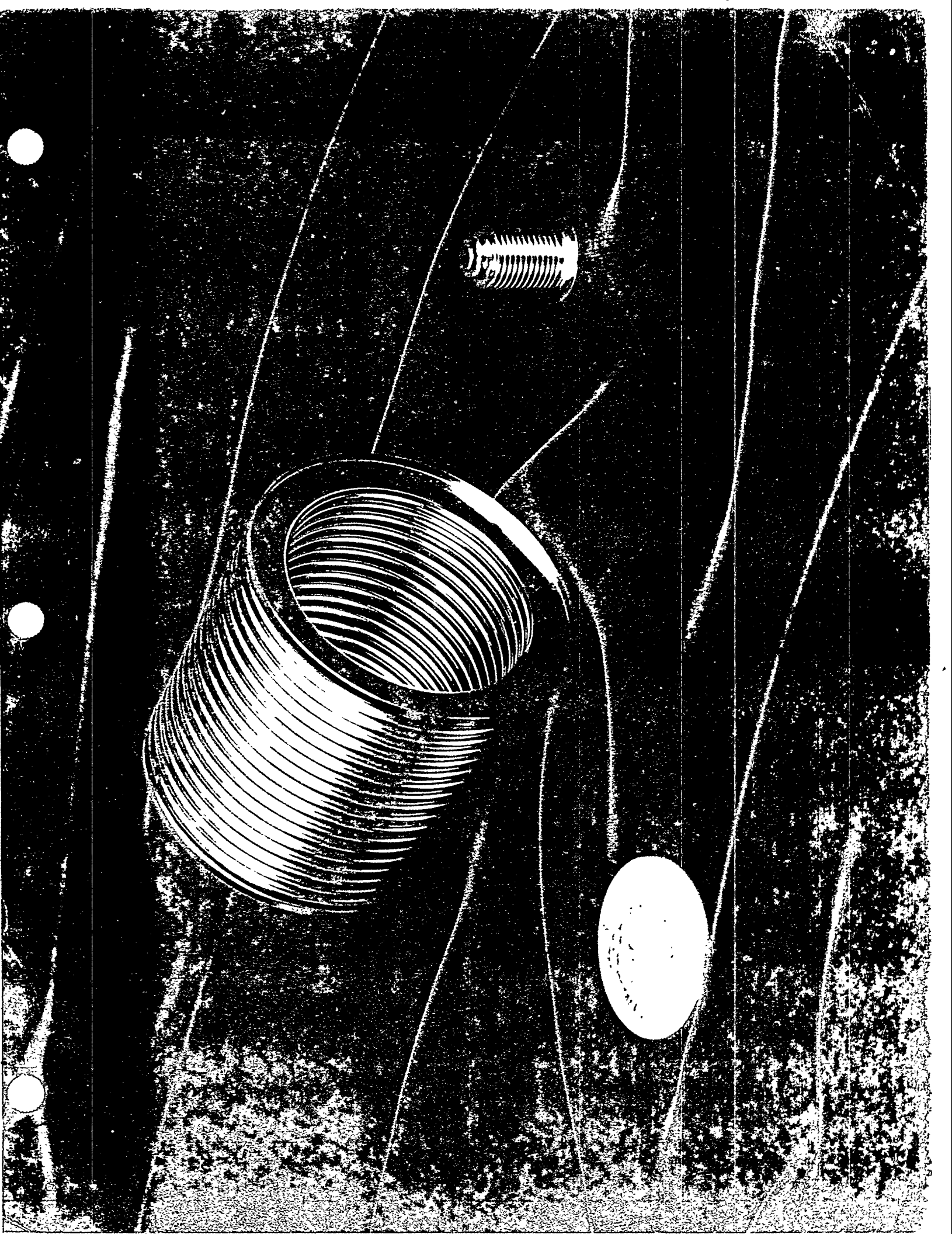
PLANNING FOR CONTINUED GROWTH THROUGH RESEARCH



While the past and present needs at the Oak Ridge Gaseous Diffusion Plant have been supported by a vigorous program of metal finishing development, the future promises even more challenging problems. Our program of applied research has yielded a breadth of capabilities unique at any installation. The successful nickel plating onto uranium, thorium, maraging steel, high silicon steels, aluminum, magnesium, stainless steel, and other metals is a demonstration of ability and perseverance.

The nickel plating of uranium, recently achieved at this plant, is considered unmatched in quality. The new process offers the users of metallic uranium a new dimension of environmental protection; and might possibly be developed for certain reactor fuel cladding requirements.

Among other techniques currently under development are the electroless plating of adherent non-porous nickel films on glass, plastics, and filament-wound vessels. The metal coating of fine particles for the development of dispersion strengthening and other uses has made unique composite materials available for other research organizations. Codeposition of oxide particles and metals is leading to another technique in strengthening metals. We expect to continue along these challenging lines toward electrodeposition of the "reluctant" metals such as molybdenum and tungsten, as alloys, and the electrodeposition of uranium and thorium oxides.

The preparation of special radiation sources has been developed at ORGDP. Electrodeposited uranium, neptunium, thorium, technetium, etc., have required an uncommon capability, which has served to help other organizations as well.

An imaginative, yet practical, program of research and development will continue to supply our needs. Our investment of talent and time is also the investment of the nation. We offer the return of that investment as a capability for further research and as a service, the breadth of which need only be challenged to be increased.