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Bibliography on Hot Isostatic Pressing (HIP) Technology

B. F. Gilp
P. D. Desai
J. F. Radavich
C. Y. Ho

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13. ABSTRACT *(Maximum 200 words)*
This report contains an annotated bibliography of 950 documents on the Hot Isostatic Pressing (HIP) Technology dealing with metals, alloys, and intermetallic compounds and covers over 450 materials. Documents published from 1966 to early 1992 are covered. Bibliographic information reported here are divided into three broad categories. The first category includes an annotated bibliography dealing with HIP technology as applied to powder metallurgy. The second category deals with casting and the third deals with miscellaneous materials which either are not properly identified or have a limited number of bibliographic citations. Within each category, bibliographic information is organized according to major alloy groups, e.g., aluminum alloys, beryllium alloys, cobalt alloys, etc., followed by bibliographies for miscellaneous alloys which are alloys either not properly identified or not having enough data to warrant a separate category. Each alloy group is further subdivided into individual commercial alloys, e.g., aluminum alloys AA 2024, AA 7075, AA 7090, etc., followed by miscellaneous aluminum alloys.

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PREFACE

This MIAC Special Report contains bibliographic information on pertinent documents dealing with hot isostatic processing technology related to metals, alloys, and intermetallics published in the period 1966 to mid-1992.

MIAC is sponsored and administered by the Defense Technical Information Center (DTIC), ATTN: DTIC-AI, Cameron Station, Building 5, Alexandria, Virginia 22304-6145, under the Information analysis Centers Program Management of Dr. Forrest R. Frank currently and Mr. Paul M. Klinefelter previously. MIAC is operated by the Center for Information and Numerical Data Analysis and Synthesis (CINDAS), Purdue University, 2595 Yeager Road, West Lafayette, Indiana 47906-1398, under the Defense Logistics Agency (DLA) Contract DLA900-90-D-0305.

MIAC is under the technical direction and monitoring of Mr. Jerome Persh, Staff Specialist for Materials and Structures, Office of the Director of Defense Research and Engineering (Science and Technology), ATTN: ODDR&E (S&T/AT), The Pentagon, Room 3D1089, Washington, DC 20301-3080.

MIAC serves as the DoD's central source of engineering and technical data and research and development information on monolithic metals, metal alloys, intermetallic compounds, and coatings utilized in Defense systems and hardware. Data and information on metal joints, welds, etc. are also covered. Emphasis is placed on those metals, alloys, intermetallic compounds, and coatings used in structural applications and/or in stringent environments.

Subject areas covered by MIAC include metals properties (especially mechanical properties as a function of temperature, and environmental conditions); latest research and development concepts, results, and trends; applications and processing of metals; processing equipment; measurement and testing of metals; test methods; quality control related to metals; corrosion/deterioration detection, prevention and control, and other environmental effects on metals and systems; producers, suppliers, and specifications for metals of concern to the DoD.

MIAC supports the Joint Logistics Commanders/Joint Directors of Laboratories Technology Initiative Panel for Advanced Materials, and provides assistance to or receives guidance from other defense programs and groups as designated by the technical monitor.

One of the authors, J. F. Radavich, is an Associate Professor in the School of Materials Engineering at Purdue University. In addition to MIAC staff who are listed on the cover of this report, MIAC staff Josephine C. F. Chen, Tanya Eurit, Pearnel Wilson, Kris Tomlinson, Greg Wood, and James Payne also contributed to the preparation of this report.

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INTRODUCTION

Hot isostatic pressing (HIP) uses a combination of elevated temperature and an inert gas pressure and is carried out in pressure vessels containing internal furnaces. HIP was invented by Saller et al. 37 years ago at Battelle Columbus Laboratories. An early Battelle report on Hot Isostatic Pressing, by Hanes et al. [1], was first issued in 1977. This report covered the history of HIPing, manufacturing systems, and studies of HIPing applications in the areas of castings, powder consolidation, and rejuvenation of used components. A more recent report in 1982 by Clauer et al. [2] reviewed more recent research dealing with the same subjects covered in the first report. Such studies confirmed the positive benefits of HIPing in a wide range of material compositions. The period of 1972-1982 in the field of HIPing may be considered as the decade of experimentation and confirmation of HIPing as a viable process to be used in the production of material components.

An important short coming of the report was the lack of information on the understanding of the metallurgical reactions which take place during the HIP process. The majority of research results focused on the closure of porosity as it affected mainly LCF and ductility. Many possible structural responses can occur when complex cast superalloys are heated in a temperature range of 1875°F to 2400°F for periods of two to four hours.

It is well known that superalloys have a wide solidification temperature range, i.e. the temperature difference between the liquidus and solidus. As the molten metal slowly solidifies, large grains and primary carbides nucleate and grow while at the same time the larger alloying elements diffuse slowly and segregate in the interdendritic regions. External and internal porosity results when the last liquid cannot fill the intertices.

The presence of surface connected porosity in the large castings prohibits internal porosity closure. Various methods of bridging over the surface porosity prior to HIPing have been tried, but a good coating method is still being sought. Perhaps, new coatings such as new boron nitride lubricant paints may provide a solution to this problem.

The HIP process can close internal casting porosity provided the proper temperature, pressure, and time conditions are selected. At the same time porosity closure is taking place, a certain degree of chemical homogenization is also taking place. However, there are undesirable reactions which can occur depending on the alloy composition. When the HIP temperature is too high, segregated areas are prone to incipient melting which cannot be rectified by thermal treatments. Another detrimental reaction is the breakdown of primary carbides and possible subsequent formation of continuous grain boundary carbide films and resultant embrittlement. In high boron content alloys, borides can also be solutioned and re-precipitated at grain boundaries. In Hf modified superalloys, the Hf can lose its beneficial effect by the formation of HfC.

It has been the authors' observation that when the as-cast gamma prime (γ') phase (the main strengthener in superalloys) is solutioned by high temperatures such as in a HIP process, the reprecipitated γ' phase due to post HIP heat treatments does not have the same composition as the as-cast γ'. The effects on mechanical properties due to the changes in such γ' are overshadowed by the positive improvements in mechanical properties with porosity closure. γ' effects on mechanical properties may be more evident in second generation HIP processing, i.e., first HIP of castings to close porosity and second HIP to rejuvenate properties.

One summation of HIP temperatures, pressures, and times for various superalloys is given by Bouse and Mihalisin [3]. They, too, caution the use of one blanket set of HIP parameters for different alloys without preliminary studies.

The uses of powders in components for high temperature service are mainly for disks and in dual alloy configurations. Powder materials are consolidated by either HIP, extrusion, and/or HIP plus forging/extrusion. Powder compacts exhibit fine grain structures and are more homogeneous in composition than cast/wrought products. The fine grain nature of consolidated powder components makes them suitable for low temperature applications like turbine disks.

Two disadvantages of the powder components are higher costs associated with powder production and the possibility of oxide inclusions being present which act as crack initiation sites for LCF failures. To overcome the problem with oxide inclusions, powder atomization processes are being developed which eliminate or replace the use of ceramic nozzles.

In the field of high temperature materials, HIP rejuvenation is now accepted as a viable method for reclaiming components which otherwise would be scrapped. Engine run components suffer from varying degrees of creep voids, internal cracking, and structural degradation. Used components which still meet all design specifications can be HIP rejuvenated by proper selection of HIP parameters and proper post HIP beat treatments to regenerate mechanical properties. Those blades which suffer from only long time structural degradation can be easily rejuvenated by thermal treatments. Successful use of HIP rejuvenation saves critical elements, reduces cycle replacement time, reduces costs, and saves on energy.

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3. Bouse, G. K. and Mihalisin, J. R., "Metallurgy of Investment Cast Superalloy Components" in *Superalloys, Supercomposites and Superceramics*, (Tien, J. K. and Caulfield, T., Editors), Academic Press, Boston, Massachusetts, 1989.

ASSESSMENT AND FUTURE TRENDS OF HIP TECHNOLOGY

HIP technology is currently a very mature technology and is being used to consolidate powders of all types, close casting porosity, promote weld integrity, rejuvenate used turbine blades and vanes, etc. After the high cost of HIP equipment, the greatest consideration or deterrent for use of HIPing of materials is the high cost of the cycle time. As the number of parts per HIP run is increased, the cost per unit decreases, but with the need to HIP large castings, the cost per unit remains very high.

A summary of the research activities in the HIP technology for powder and cast components is presented in the following table.

Summary of Research Activities in HIP Technology for Powder and Cast Components

Alloy	Number of Publications*						
	1966-1969	1970-1974	1975-1979	1980-1984	1985-1989	1990-1992	Total
Aluminum	0 (0)	6 (0)	4 (0)	21 (2)	8 (7)	3 (3)	54
Beryllium	3 (0)	23 (0)	26 (0)	8 (0)	3 (0)	0 (0)	63
Cobalt	0 (0)	11 (2)	4 (2)	7 (2)	3 (3)	2 (0)	36
Iron	0 (0)	11 (5)	26 (5)	37 (13)	15 (7)	10 (1)	130
Nickel	0 (0)	25 (4)	72 (37)	84 (61)	41 (53)	5 (7)	389
Refractories	0 (0)	3 (2)	1 (0)	4 (1)	5 (0)	3 (0)	19
Titanium	0 (0)	11 (1)	34 (27)	84 (35)	47 (21)	5 (0)	265
Intermetallics	0 (0)	0 (0)	1 (0)	5 (2)	17 (4)	42 (3)	74
	3 (0)	90 (14)	168 (71)	250 (116)	139 (95)	70 (14)	1,030

* Number in parentheses are for cast components.

The major thrust of the research in the early to mid-Seventies was to use beryllium to fabricate structural materials by HIPing. Attempts to develop cast and wrought beryllium products resulted in limited commercial success. Powder metallurgy techniques have been used to fabricate components for structural applications. Since beryllium is a relatively expensive material, most of the efforts were on the other cost cutting measures such as machining costs, scrap losses, and development of net shape components. However, interest in using HIPing technology for commercial fabrication of structural components slowly diminished which is evident from the number of documents published in the Eighties. Research activities in this decade were concentrated on nickel (and to a lesser extent, iron) superalloys and titanium alloys. The relative ease to produce near net shape components was the driving force behind acceptance of superalloys. Interests in the intermetallic alloys have increased significantly in the late Eighties and early Nineties.

Superalloys

Large Structural Castings

The development of new aircraft engines requires larger and more complex structural castings. It is estimated that the use of castings will increase by a factor of four before 1994 and the use of castings greater than 40 inches will increase even more substantially.

Currently, large structural components, such as engine cases, rings, frames, and supports, are made of various cast and wrought pieces joined together by welding and/or brazing. If extensive welding is required, distortion, increased costs, and long cycle times result.

An example of one such structural component is the CF6-80A turbine frame made of alloy 718 and weighing over 150 Kg (330 lb.) and 135 cm (53.15 in.) diameter with 61 separate pieces of varying wall thicknesses which must be joined by welding. By producing this component as a single casting, cycle time and distortion is greatly reduced and a $20,000 cost reduction is realized.

Large structural castings are also being made of newer cast alloys such as René-220C, GTD-222, René-108 and IN-939. The trend is to go to Ni base superalloys for higher temperature applications and greater oxidation/sulphidation resistance. However, the structural responses to high temperature thermal treatments like welding repair, HIP, and longtime service needs to be characterized.

In order to successfully HIP fine grain components without grain growth, the HIP temperatures must be lower and the pressures higher. The HIP parameters selected must close porosity, minimize grain growth, and partially homogenize segregation. Generally, fine grain castings are given preHIP thermal treatments to help reduce segregation so as to minimize potential incipient melting.

At this same time, casting vendors have developed new casting techniques to produce fine grains and incorporating a HIP step to close porosity. Advances in wax and mold technologies coupled with the use of robotics for dipping large molds made possible production of large structural castings. Two fine grain casting processes, Grainex and Microcast-X have been developed by the Howmet Corporation, as well as a fine grain process by Precision Castparts.

Two main problems exist in the HIPing of large castings. The first problem is that larger HIP furnaces are required to accommodate the larger structural castings of the future. Currently, HIP furnace manufacturers are developing or have developed furnaces with hot zones up to 60 inches in diameter.

The second critical problem in HIPing is that the cycle time for a HIP run is too long. Because the long cool down in the HIP furnace produces undesirable structures, a post HIP solution heat treatment is necessary before final aging can take place to develop the mechanical properties. Two procedures are currently being explored to reduce cycle time. One method involves the cooling of the pressurizing gas by external heat exchangers. A process to do this has been developed by ABB Autoclave Systems, Inc. which is called "HIP Quenching." The other method is to cool the pressurizing gas by introduction of cool gas. Both methods are promising but the critical factor is whether the material can be cooled uniformly.

Quick HIP

A recent development to reduce cycle time is a process called Quick HIP. In this process the material is first heated externally to the HIP furnace and then given a quick HIP at high pressures in a pressurized furnace. This technology would reduce the heating and cooling part of the conventional HIP cycle. This is still in the experimental stages for this technology.

Cast Turbine Blades

During the decade of 1982-1992, equiaxed and D. S. turbine blades were being routinely HIPed to close casting porosity. Since most of the blade components are large grain structures, grain growth during HIPing is not a problem. However, in the case of single crystal blades, closure of casting porosity at high temperatures may be accompanied by the formation of areas of small recrystallized grains which are unacceptable for high temperature operation. Opinions are divided over whether to HIP single crystals due to the possibility of producing recrystallized grains; however, more single crystal blades are being HIPed without encountering the recrystallization effect. Since the HIP temperature controls the tendency for the recrystallization process, HIPing of single crystal blades should be done at the lowest possible HIP temperature for porosity closure.

Turbine Disks

Currently some turbine disks are made of powder, but the majority of disks are small grain wrought products. Materials being considered for disk applications are conventional alloys but subsolvus (gamma prime) processed to retain fine grain structures. However, when these materials are subsolvus processed, the yield of the final component is so low that the resultant high material cost makes powder disks of the same composition very competitive.

HIP rejuvenation studies of used wrought turbine disks have been unsuccessful since the high temperatures involved in the HIP process produces large grain growth. This would make such disks unacceptable for low temperature applications. However, used powder turbine disks might be amenable to HIP rejuvenation since fine grains in powder components resist grain growth to a much higher temperature than their wrought counterparts.

Titanium Alloys

The strength to density ratio of titanium alloys coupled with their fracture toughness and fatigue properties make them attractive for aeronautical and space applications. First Ti-6Al-4V and later Ti-6Al-2Sn-4Zr-2Mo were used in early gas turbine engines but as the operating temperature increased these were replaced with nickel superalloys. In advanced gas turbine engines, titanium alloys are used mainly as compressor discs and fan blades. Today titanium alloys are more important as structural materials for modern warplanes and spacecraft.

Research on HIPing of titanium alloys focused mainly on fabrication of powder components and near net shape forming. These processes make titanium alloys more economical by increasing low temperature strength and while limiting scrap material and machining cost. This was demonstrated by using P/M near net shaped Ti-6Al-6V-2Sn for fuselage braces on the navy F-14A. Also investigated was increasing the performance of titanium castings as well as repair and rejuvenation of used titanium castings. HIPing of titanium castings can close cracks and remove the porosity thus increasing the strength and fatigue life. HIPing is essential for castings that are to be machined or welded.

Intermetallics

The main advantages of intermetallic alloys over conventional alloys for high temperature structural applications are high melting points, low density, good high temperature strength and oxidation resistance. While the major disadvantages have been room temperature ductility and fabrication, pursued mainly as aircraft turbine engine materials, the aluminides and silicides have shown the most promise. Particularly, monolithic as well as composites of TiAl, Ti_3Al, Ti_2AlNb, NiAl and $MoSi_2$ have been considered for both compressor blades, vanes, discs and shafts and turbine blades, discs and nozzles.

Other intermetallic alloys, most noticeably Fe_3Al and Ni_3Al, are already in use as or are being tested for applications such as dies for Fe-B-Nd automotive magnets, automotive turbocharger rotors, roller bearings, hydroturbines and feed water pumps with improved cavitation erosion resistance, heating elements for toasters and clothes dryers, hot gas filters for coal gassification systems and coatings for oxidation and sulfidation resistance.

Recommendations

It is an accepted fact that porosity closure of castings reduces the amount of materials scrapped, but care should be exercised to reject any trend to lower the initial high quality of materials on the premise that HIPing will make poor quality materials good.

In the future more emphasis should be placed on the re-use of engine run components by application of the HIP rejuvenation technologies. In addition, ongoing structural studies coupled with HIP cycles need to be carried out on newer and more complicated cast alloys which are being considered for long time operation at increasingly higher temperatures.

ORGANIZATION

The Bibliography on Hot Isostatic Pressing (HIP) Technology presented here is concerned with HIP of unalloyed metals, metal alloys, and intermetallic compounds. Most of the literature cited deals with structural materials and/or materials designed to perform at high temperatures. The emphasis is placed on HIP techniques, microstructural changes, and effects on creep, fatigue, corrosion, and mechanical properties.

This bibliography contains 950 individual citations published from 1966 to mid-1992 and covers over 450 different materials organized on three hierarchical levels. The first level is the material processing (powder metallurgy, casting, or miscellaneous); the second is material class (nickel alloys, aluminum alloys, intermetallic compounds, and so forth); and the third is the specific alloy (Udimet 700, NiAl, Ti-6Al-4V, and so forth). Within each level, a miscellaneous category contains either undefined materials or specific materials for which there were insufficient entries to warrant a separate category.

The miscellaneous category in the first level contains all materials that could not be properly identified either as powder metallurgy or cast materials. This section also includes citations on HIP equipment, computer simulations, or theoretical models. In the second level, the miscellaneous category includes citations on material classes that do not warrant separate sections and citations that specify the processing condition but not the material class. For example, the "Powder Metallurgy/Miscellaneous" section may include a citation with information on ball milled material without detailing material class as well as a citation for powder metallurgy Mg-5Li-5Si alloy. At the innermost or third level, the miscellaneous category contains those specific materials with only a few citations and materials referred to by material class only. A citation, for example, on cast aluminum alloys which does not specify alloy type would be found in the section for " Cast Materials/Aluminum Alloys/Miscellaneous Materials," along with a citation on cast AA 6061 which has only a few citations. A complete alphabetical list of materials covered in this report, with the pages on which they appear, is included at the end of the report under "MATERIALS LIST." An alphabetical list of the most common keywords is also included in the "INDEX TERMS."

This report is organized so that each section is complete and self-contained. This means that a given citation is listed more than once whenever the cited work covers more than one material. An entry for a journal article on the "Microstructure and Property Improvements in 7075 and 8090 Aluminum Alloys by Spray Forming" will be cited in the section for AA7075 and also will be repeated in the section for AA8090. An entry for a report on the "Mechanical Property Difference Between HIP Powder Metallurgy and HIP Cast Ti-6Al-AV" will be cited in the "Powder Metallurgy" section as well as in the "Castings" section for that material. By organizing the report in this fashion, cross referencing is eliminated; all pertinent entries are listed under every area of coverage, and only the area or areas of interest need to be searched to find the needed information. Citations in each section are listed in reverse chronological order. This should make searches quicker and more efficient.

For alloys that have different commercial designations but the same/similar composition, and are therefore considered the same material, a list of those encountered in the report appears below:

1. Udimet 700, Astroloy, APK1, Nimonic AP1, Rene' 77

2. MA753, IN-853

3. C-103, WC-103
4. Alloy 454, PWA 1480
5. Mar-M250, Maraging (250)
6. Rene 150, PA 101 (low C)
7. Inconel 718, IN-718, Pyromet 718
8. X-40, X-45 (low C)
9. Maraging 300, Vascomax 300
10. HP 9-4-20 steel, 9Ni-4Co
11. A-286, JBK-75
12. IN-100, Rene' 100

To facilitate document acquisition, the appropriate identification numbers are provided: the Defense Technical Information Center (DTIC) AD- number; Department of Defense (DoD) or NASA report number, for government sponsored reports; corporate report number, for items that do not have a government report number; the contract number, when a report number is not available. For reports produced outside of North America, an NTIS number, if available, is cited instead of a report or contract number.

ANNOTATED BIBLIOGRAPHY

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ALUMINUM ALLOYS

AA 2024

1. **Modern Powder Metallurgy Science and Technology**
   Lawley, A.
   J Met 38 (8), 15-25, 1986 (AD-D136 435)
   Key Words: NiAl, IN-100, MAR-M509, RENE' 95, AA 2024-T6, consolidation, REP, tensile properties, impact toughness

2. **Aluminum Powder Metallurgy Technology for High Strength Applications**
   Pickens, J. R.
   J Mater Sci 16 (6), 1437-57, 1981 (AD-D121 608)
   Key Words: AA 3003, AA 5083, AA 2024-T4, AA 7075-T6, AA 2024-T3510, AA 7075-T6510, MA67, MA87, IN9051, AA 7075-T73, AA 7475-T651, AA 7475-T7351, AA 7050-T3651, AA 7050-T651, AA 7050-T7351, AA 2124-T851, Al-4Ti, Al-8Fe, degassing, tensile properties, fatigue, fracture toughness, stress corrosion

3. **Structure and Property Control through Rapid Quenching of Liquid Metals**
   Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
   Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
   Contract No : DAHC15-70-C-0283, 411 pp., 1973 (AD-775 225)
   Key Words: AA 7075, AA 2024, AISI 1045, IN-100, MAR-M509, Maraging 300, tensile properties

4. **Liquid-Metal Atomization for Hot Working Preforms**
   Grant, N. J., Pelloux, R. M.
   Massachusetts Institute of Technology, Department of Metallurgy and Materials Science, Cambridge, MA
   Proc First Army Materials Technology Conf, 317-36, 1972 (AD-D109 742)
   Key Words: AA 2024-T4, IN-100, MAR-M509, atomization, silicon addition hafnium addition, tensile properties, fatigue, segregation

5. **Specialty Methods of Powder Atomization**
   Grant, N. J.
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   Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center, Raquette Lake, NY, Aug-Sept 71, 13 pp., 1971 (AD-181 533)
   Key Words: IN-100, Maraging 300, 18/8 stainless, AA 2024, X-45, AISI 316, REP, microstructure, ultrasonic testing, fatigue, tensile properties

AA 7075

1. **Microstructural and Property Improvements in 7075 and 8090 Aluminum Alloys by Spray Forming**
   Lewis, R. E., Davinroy, Al T., Kaufman, M. J.
   Metal Powder Industries Federation, Princeton, NJ
   Proc Symp P/M in Aerospace and Defense Technologies 185-92, 1991
   Key Words: AA 7075, AA 8090, properties improvements, spray forming, tensile properties, fracture toughness

2. **Recent R & D of Aluminum Alloys for Aircraft Applications-- Part 3, Powder Metallurgy Alloys**
Yamauchi, S.
Sumitomo Light Metal Technical Reports 29 (1), 69-81, 1988 (AD-D138 979)
Key Words: AA 7091, AA 7090, AA 7064, AA 7075, AA 7050, mechanical alloying, tensile properties, fatigue, fracture toughness

3. **Advanced Processing and Properties of High Performance Alloys**
Koss, D. A.
Department of Materials Science and Engineering, Pennsylvania State University, University Park, PA
Technical Report Number Six
Contract No : N00014-86-K-0381
41 pp., 1987 (AD-A183 566)
Key Words: titanium, Ti-10Al, AA 7075, AA 1100, erbium addition, porosity, voids, rapid solidification, fatigue, deformation, fracture mechanics

4. **Advanced Processing and Properties of High-Performance Alloys**
Koss, D. A.
Department of Metallurgical Engineering, Michigan Tech University, Houghton
Technical Report Number Four
Contract No : N00014-85-K-0427
19 pp., 1986 (AD-A167 404)
Key Words: Ti-6Al-4V, AA 7075-T6, AA 1100, AISI 316, fabrication, rapid solidification

5. **Advanced Processing and Properties of High-Performance Alloys**
Koss, D. A.
Department of Metallurgical Engineering, Michigan Tech University, Houghton
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Contract No : N00014-85-K-0427
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Key Words: Ti-6Al, AA 7075-T6, AA 1100, tensile properties, fatigue, rapid solidification

6. **Deformation and Fracture of P/M (Powder/Metallurgy) Titanium Alloys**
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Rept No : AFWAL-TR-83-4131, 54 pp., 1983 (AD-D139 731L)
Key Words: Ti-6Al-4V, AA 7091, IN9051, AA 7075, turbine components, tensile properties, fatigue, bending

8. **Forging Technologies for the Aerospace Industry**
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Rept No : NASA-CR-169070, 16 pp., 1982 (AD-D126 287)
Key Words: Udimet 700, AA 7075, stainless steel, maraging steel, tensile properties, microstructure, splat quenching

10. **Rapidly Solidified (RS) Aluminum Alloys-Status and Prospects**
Author Anon
National Materials Advisory Board (NAS-NAE), Washington DC
Final Report
Rept No : NMAB-368, 130 pp., 1981 (AD-B058 007L)
Key Words: AA 7475, MA67, MA87, AA 2124, AA 7075, extrusion, rapid solidification, dendrite structure

11. **RSR-A Frontier in Materials**
Tortolano, F. W.
Design News 37 (8), 34-6, 1981 (AD-D121 254)
Key Words: AA 7075-T6, AA 2014, turbine components, creep rupture, tensile properties, fatigue, rapid solidification, cost

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Sumitomo Light Metal Technical Reports 29 (1), 69-81, 1988 (AD-D138 979)
Key Words: AA 7091, AA 7090, AA 7064, AA 7075, AA 7050, mechanical alloying, tensile properties, fatigue, fracture toughness

2. **Powder Metallurgy of Light Metal Alloys for Demanding Applications**
Froes, F. H., Pickens, J. R.
Air Force Wright Aeronautical Labs, Wright-Patterson AFB, OH
Met Rept No : AFWAL-TR-84-4084, 36 (1), 18 pp., 1984 (AD-A142 066)
Key Words: AA 7090, AA 7091, Ti-6Al-4V, rapid solidification, mechanical attritioning, tensile properties

3. **Powder Metallurgy Gaining Trust of Aero Designers**
Wigotsky, V.
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Key Words: Ti-6Al-4V, RENE' 95, AA 7090, AA 7091, Al-8Fe, turbine components, shear properties, compressive properties, net shape forming

4. **The New Frontiers of Powder Metals**
Vaccari, J. A.
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Key Words: AA 7090, AA 7091, IN9052, Ti-6Al-4V, Monel 400, Inconel 600, RENE' 95, Cb291, Udimet 700, IN-100, AF-115, Inconel 625, net shape forming, injection molding, applications, forging

5. **Forging Technologies for the Aerospace Industry**
Gold, R.
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Key Words: AA 7075, AA X7090, AA X7091, Boeing 757, aircraft structures, net shape forming

AA 7091

1. **Recent R & D of Aluminum Alloys for Aircraft Applications-- Part 3, Powder Metallurgy Alloys**
Yamauchi, S.
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4. **Mechanical Property Microstructure Relationships in Alloys**
Eylon, D., Kim, Y. W.
Metcut Research Associates Inc., Materials Research Group, Wright-Patterson AFB, OH
Final Report Sep 79-Jan 83
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Key Words: Ti-6Al-4V, AA 7091, IN9051, AA 7075, turbine components, tensile properties, fatigue, bending

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Key Words: AA 7090, AA 7091, IN9052, Ti-6Al-4V, Monel 400, Inconel 600, RENE' 95, Cb291, Udimet 700, IN-100, AF-115, Inconel 625, net shape forming, injection molding, applications, forging

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Department of Materials Science and Engineering, Pennsylvania State University, University Park, PA
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Key Words: Ti-6Al-4V, AA 7075-T6, AA 1100, AISI 316, fabrication, rapid solidification

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Author Anon
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Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

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Key Words: AA 7090, AA 7091, IN9052, Ti-6Al-4V, Monel 400, Inconel 600, RENE' 95, Cb291, Udimet 700, IN-100, AF-115, Inconel 625, net shape forming, injection molding, applications, forging

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Key Words: aluminum alloys, titanium alloys, melt spinning, test equipment

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Fatemi, M., Rath, B.B.
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Key Words: Al-4Cu, Ti-6Al-4V, 21-6-9 steel, microstructure, neutron scattering, tensile creep, plastic deformation

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Rept No : AFWAL-TR-82-4136, 168 pp., 1982 (AD-A122 963)
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21. **The State of the Science and Art of Powder Metallurgy**
Lenel, F. V., Ansell, G. S.
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Key Words: beryllium, MAR-M200, Ti-6Al-4V, MA67, MA6000E, steel, tensile properties, sintering

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Author Anon
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Key Words: AA 7475, MA67, MA87, AA 2124, AA 7075, extrusion, rapid solidification, dendrite structure

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Key Words: AA 7075-T6, AA 2014, turbine components, creep rupture, tensile properties, fatigue, rapid solidification, cost

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Pickens, J. R.
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Key Words: AA 3003, AA 5083, AA 2024-T4, AA 7075-T6, AA 2024-T3510, AA 7075-T6510, MA67, MA87, IN9051, AA 7075-T73, AA 7475-T651, AA 7475-T7351, AA 7050-T3651, AA 7050-T651, AA 7050-T7351, AA 2124-T851, Al-4Ti, Al-[illegible]Fe, degassing, tensile properties, fatigue, fracture toughness, stress corrosion

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Key Words: aluminum alloys, nickel alloys, microstructure, hot extrusion, rapid solidification

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Key Words: titanium, aluminum, density, fabrication

29. **Powder Forging**
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Int Metall Rev 23 (5), 209-39, 1978 (AD-D114 204)
Key Words: titanium alloys, aluminum alloys, nickel alloys, beryllium, porosity, plasticity, impact strength, tensile properties, fatigue, sintering, cost, preheating

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Rept No : MCIC-77-34, 101 pp., 1977 (AD-A049 227)
Key Words: T-111, Ti-6Al-4V, AA A356-T61, IN-738, RENE' 80, Udimet 700, IN-792, welding, tensile properties, pressure bonding

BERYLLIUM AND BERYLLIUM ALLOYS

Beryllium

1. **Fracture Toughness of CIP-HIP Beryllium at Elevated Temp**
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Key Words: beryllium, fracture toughness, crack propagation, crack arrest

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Key Words: beryllium, tensile properties, passive systems

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Key Words: beryllium, pitting, microstructure, voids

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Rept No : UCRL-87392, 59 pp., 1982 (AD-D127 287)
Key Words: beryllium, density, grain size, tensile properties, strain rate dependence

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Kaltenbach, K.
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Key Words: beryllium, copper addition, microstructure, grain size, bend test

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McCarthy, J., Petri, F.
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Key Words: beryllium, dimensional stability, tensile properties

8. **The Influence of Purity Level on the Mechanical Properties of Hot Isostatically Pressed Beryllium**
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Sandia Labs, Livermore, CA
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Key Words: beryllium, grain size, fracture toughness, compressive properties

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Key Words: beryllium, grain size, cleavage, metallography nondestructive testing, cracking

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Key Words: titanium alloys, aluminum alloys, nickel alloys, beryllium, porosity, plasticity, impact strength, tensile properties, fatigue, sintering, cost, preheating

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Key Words: beryllium, re-entry vehicles, nose cones, porosity, density, tensile properties, fabrication, temperature effect, cold pressing

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Hanes, H. D.
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Key Words: beryllium, microstructure, plasma spraying

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Key Words: AISI 4340, beryllium, Ti-6Al-4V, pressure vessels

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Turner, G. I., Lane, R. A., Lancaster, R. A.
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Proc 4th Int Conf Beryllium Paper No. 12, 10 pp., 1977 (AD-D113 187)
Key Words: beryllium, microcracking, cleavage, fracture mechanics temperature effect, activation energy

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Aldinger, F., Gold, E., Petzow, G.
The Royal Society, London, UK
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Key Words: beryllium, grain size, grain refinement, microstructure morphology, particle size, tensile properties, hardness fracture surface, density

16. **High-Strength Beryllium Block**
Pinto, N. P., Keith, G. H.
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Key Words: beryllium, tensile properties, grain size, creep properties fracture toughness, ball milling

17. **Strength-Ductility Relationships in Intermediate Purity Hot-Pressed Beryllium**
Stonehouse, A. J., Bielawski, C. A., Paine, R. M.
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Proc 4th Int Conf Beryllium Paper No. 17, 12 pp., 1977 (AD-D113 192)
Key Words: beryllium, tensile properties, particle size

18. **Temperature Effects on Mechanical Properties of CIP/HIP-1 Beryllium**
Dignam, J. F., Aronin, L. R., Chou, S. C., Rainey, J. H.
The Royal Society, London, UK
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Key Words: beryllium, tensile properties, compressive properties temperature effect

19. **Mechanical Behavior of CIP/HIP-1 Beryllium as a Function of Strain Rate and Stress History**
Chou, S. C., Aronin, L. R., Kignam, J. F., Rainey, J. H.
The Royal Society, London, UK
Proc 4th Int Conf Beryllium Paper No. 20, 12 pp., 1977 (AD-D113 195)
Key Words: beryllium, tensile properties, Poisson's ratio, compression test

20. **Beryllium with Controlled Porosity**
Pinto, N. P., Hanes, H. S.
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Proc 4th Int Conf Beryllium Paper No. 31, 11 pp., 1977 (AD-D113 204)
Key Words: beryllium, porosity, density, tensile properties, temperature effect, particle size, annealing

21. **Hot Isopressing Beryllium--The Effect of Temperature and Pressure**
Roberts, D., Lowe, J. N., Turner, G. I.
The Royal Society, London, UK
Proc 4th Int Conf Beryllium Paper No. 32, 13 pp., 1977 (AD-D113 205)
Key Words: beryllium, tensile properties, density, temperature effect

22. **The Development, Evaluation and Manufacturing Capability of Beryllium Bar Stock using the CIP-HIP Process**
Lowe, J. N., Turner, G. L., Bunce, J. E. J.
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Proc 4th Int Conf Beryllium Paper No. 33, 13 pp., 1977 (AD-D113 206)
Key Words: beryllium, tensile properties, fabrication

23. **HIP Fabrication of Experimental Mirror Substructure**
Mueller, J. J.
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Proc 4th Int Conf Beryllium Paper No. 34, 18 pp., 1977 (AD-D113 207)
Key Words: beryllium, copper, mirror, coatings, temperature effect

24. **Confidence in Beryllium**
Channon, S. L.
The Royal Society, London, UK
Proc 4th Int Conf Beryllium Paper No. 48, 11 pp., 1977 (AD-D113 215)
Key Words: beryllium, applications, tensile properties, compressive properties, plasma deposition, cost

25. **Fabrication and Evaluation of Hot Isostatically Pressed Beryllium**
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Kawecki Berylco Industries Inc., Reading, PA
Contract No : F33615-75-C-5041, 18 pp., 1976 (AD-A024 780)
Key Words: beryllium, beryllium alloys, machining, etching, tensile properties

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Webster, D., Greene, R. L., Lawley, R. W., London, G. J.
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Key Words: beryllium, oxygen addition, silicon addition, tensile properties, microstructure, grain size, grain growth, grain boundaries, Charpy impact

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Key Words: beryllium, tensile properties, grain size, density, impurities, oxide addition, single crystals

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Nicholas, T.
Air Force Materials Lab, Wright-Patterson AFB, OH
Rept No : AFML-TR-75-168, 40 pp., 1975 (AD-A020 076)
Key Words: beryllium, plasma deposition, tensile properties, fracture mechanics, ductility

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Nicholas, T., Sever, M. J.
Air Force Materials Lab, Wright-Patterson AFB, OH
Final Report, Nov 72-Jun 73
Rept No : AFML-TR-73-258 , 31 pp., 1974 (AD-781 065)
Key Words: beryllium, stress-strain, bend test, flow properties

30. **Investigation of Creep Mechanisms and Development of Creep Resistant Beryllium**
Crooks, D. D., Crossman, F. W., Webster, D.
Lockheed Missiles and Space Co. Inc., Palo Alto, CA
Final report May 72-May 74
Rept No : LMSC-D402660, 193 pp., 1974 (AD-923 481L)
Key Words: beryllium, re-entry vehicles, oxide addition, aluminum addition, silicon addition, creep, grain size, plastic deformation, dislocation density, finite element analysis

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Pinto, N. P., Martin, A. J.
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Key Words: beryllium, grain growth, recrystallization, density, tensile properties, texture

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Mueller, J. J., Hanes. H. D.
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Key Words: beryllium, shear strength, diffusion bonding, thin film

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Rept No : AFML-TR-72-263, 268 pp., 1972 (AD-908 569L)
Key Words: beryllium, MPDC, GB-2, re-entry vehicles, microstructure, tensile properties, outgassing, fabrication, cost, heat treatment

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Key Words: beryllium, tensile powder, rupture modulus

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41. **Technical Note on Fabricating Isotropic Beryllium**
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Key Words: beryllium, pressureless sintering

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Beryllium Alloys

1. **Properties of Beryllium Consolidated By Several Near-net Shape Processes**
   Hashiguchi, D.H., Clement, T.P., Marder, J.M.
   J Mater Shaping Technol 7 (1), 23-31, 1989 (AD-D143 267)
   Key Words: beryllium alloys, grain size, powder metallurgy, net shape forming, tensile properties

2. **Materials Research for Advanced Inertial Instrumentation Task 1. Dimensional Stability of Gyroscope Structural Materials**
   Kumar, K., Cardarelli, D., Petri, F.
   Charles Stark Draper Lab Inc., Cambridge, MA
   Technical Research Report Number Five
   Rept No : R-1612, , 53 pp., 1982 (AD-A125 763)
   Key Words: HIP 50, X-520, microstructure, microscopy, microcreep

3. **Materials Research for Advanced Inertial Instrumentation Task 2. Gas Bearing Material Development**
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   Technical Research Report Number Five
   Rept No : CSDL-R-1647, 89 pp., 1982 (AD-A130 471)
   Key Words: beryllium alloys, microstructure, metallography, ion implantation, wear tests

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   Key Words: HIP 50, Be alloy X-520, microstructure, creep, tensile properties, dimensional stability, x-ray diffraction

5. **A Fundamental Study of Flow and Fracture in Beryllium**
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   Final Report
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   Key Words: beryllium alloys, grain refinement, thermomechanical treatment, tensile properties

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   Key Words: HIP 50, beryllium alloys, tensile properties, compressive properties, grain size

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   Kawecki Berylco Industries Inc., Reading, PA
   Final Technical Report
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Key Words: S-65 beryllium, fractography, tensile properties, hardness

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Key Words: S-65, P1, beryllium alloys, beryllium oxide addition, stress intensity, tensile properties, notch properties

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Key Words: RR242, RR243, BSP9, BSP10, T30, 9776, 9715, 1707, 1353, 8084, creep, grain size, dislocation density, annealing

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Key Words: beryllium alloys, grain size, deformation, plasma deposition, tensile properties

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Key Words: Lockalloy, beryllium alloys, beryllium oxide addition, compressive properties

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Key Words: beryllium alloys, microstructure, grain size, ductility, tensile properties, hardness, stress relieving

14. **Manufacturing Methods for the Production of Disk Shapes by Contour Rolling**
Arnold, David B.
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Key Words: RENE' 95, MPDC, turbine components, microstructure, grain size, tensile properties, machining, creep rupture

15. **Manufacture of Beryllium Structures**
Denny, John P., Burns, Robert H., Solbach, Robert C., Schoenly, D. K.
Frauson, W. O.
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Final Report Nov 72-Mar 73
Rept No : AFML-TR-73-251, 56 pp., 1973 (AD-917 815L)
Key Words: MPDC, beryllium, nose cones, tensile properties, fracture surface, machining, fabrication

16. **Establishment of a Manufacturing Process for Thin Walled Conical Beryllium Structures Involving Hot Isostatic Pressing**
Mueller, J. J., Hanes, H. D.
Battelle Memorial Institute, Columbus, OH
Final Technical Report Dec 69-Jul 72
Rept No : AFML-TR-72-263, 268 pp., 1972 (AD-908 569L)
Key Words: beryllium, MPDC, GB-2, re-entry vehicles, microstructure, tensile properties, outgassing, fabrication, cost, heat treatment

17. **Establishment of a Manufacturing Process for Thin Walled Conical Beryllium Structures Involving Hot Isostatic Pressing**
Mueller, J. J., Hanes, H. D.
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Rept No : RTD-IR-271-9(I), 48 pp., 1970 (AD-D105 337L)
Key Words: SP-200, SP-350, P-21, P-50, GB-2, beryllium alloys, tensile properties, fracture, outgassing, bubble formation

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Key Words: GB-2, beryllium alloys, particle size, density, tooling

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Key Words: SP-200,MPDC, tensile properties, plastic deformation, permeability

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Meyer, G. E., Henning, H. J.
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Key Words: S-200, beryllium alloys, tensile properties

COBALT ALLOYS

MAR-M509

1. **Modern Powder Metallurgy Science and Technology**
   Lawley, A.
   J Met 38 (8), 15-25, 1986 (AD-D136 435)
   Key Words: NiAl, IN-100, MAR-M509, RENE' 95, AA 2024-T6, consolidation, REP, tensile properties, impact toughness

2. **Hot Workability of Cobalt-Base Superalloys Produced via Powder Metallurgy**
   Hellner, L., Johansson, H.
   Powder Metall Int 8 (2), 82-6, 1976 (AD-D107 172)
   Key Words: X-40, MAR-M509, superplasticity, hot working microstructure, cracking, tensile properties, temperature effect

3. **Study of Superalloys Produced via Powder Metallurgy**
   Hellner, L., Johansson, H.
   NTIS, N77-13210, Springfield, VA
   Final Report
   Rept No : N77-13210, 56 pp., 1975 (AD-D109 492)
   Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking, microstructure, temperature effect, deformation, stress intensity, tensile properties

4. **Application of Hot-Isostatic Pressing, Hydrostatic Extrusion, and Deformable-Die Tube Tapering Processes to Production of Titanium-6Al-4V Tapered Tubes**
   Meyer, G. E., Harth, G. H., Houck, J. A., Byrer, T. G.
   Battelle Memorial Institute, Columbus, OH
   Technical Report
   Rept No : USAAMRDL-TR-72-71, 86 pp., 1973 (AD-759 504)
   Key Words: MAR-M509, IN-100, Ti-6Al-4V, turbine components, microstructure, thermomechanics, die forging, cold drawing, extrusion

5. **Structure and Property Control through Rapid Quenching of Liquid Metals**
   Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
   Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
   Final Technical Report
   Contract No : DAHC15-70-C-0283
   411 pp., 1973 (AD-775 225)
   Key Words: AA 7075, AA 2024, AISI 1045, IN-100, MAR-M509, Maraging 300, tensile properties

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   Grant, N. J., Pelloux, R. M., Regis, M. N., Flemings, M. C., Merton, C.
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   Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
   Semi-Annual Technical Report Number Three Jul-Dec 1971
   Contract No : DAHC15-70-C-0283
   130 pp., 1972 (AD-739 340)
   Key Words: IN-100, MAR-M509, Maraging 300, microstructure, tensile properties, fatigue, hardness, creep rupture, fracture toughness

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Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Semi-Annual Technical Report Number Four, Jan-Jul 1972
Contract No : DAHC15-70-C-0283, 140 pp., 1972 (AD-749 679)
Key Words: AA 7075, IN-100, MAR-M509, AISI 1045, Maraging 300, microstructure, fractography, tensile properties

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Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Semi-Annual Technical Report Number Five, Jul-Dec 1972
Contract No : DAHC15-70-C-0283, 128 pp., 1972 (AD-757 677)
Key Words: IN-100, MAR-M509, 18Ni steel, microstructure, hot working, creep properties, strain rate, tensile properties

9. **Liquid-Metal Atomization for Hot Working Preforms**
Grant, N. J., Pelloux, R. M.
Massachusetts Institute of Technology, Department of Metallurgy and Materials Science, Cambridge, MA
Proc First Army Materials Technology Conf, 317-36, 1972 (AD-D109 742)
Key Words: AA 2024-T4, IN-100, MAR-M509, atomization, silicon addition hafnium addition, tensile properties, fatigue, segregation

10. **Coarse Powder Techniques**
Widmer, R.
Industrial Materials Technology Inc., Woburn, MA
Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center, Raquette Lake, NY, Aug-Sept 71, 16 pp., 1971 (AD-181 534)
Key Words: IN-100, Maraging 300, X-45, MAR-M509, Hastelloy X, Udimet 710, Alloy 713, Ti-6Al-6V-2Sn, microstructure, creep rupture, tensile properties

11. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
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Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Semi-Annual Technical Report Number Two Jan-Jun 1971
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Key Words: IN-100, Vascomax 300, MAR-M509, extrusion, tensile properties, creep rupture, quenching

Stellite 6

1. **The Production and Processing of High-Quality Powder Metallurgy Materials**
Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W.
Powder Metall Int 23 (4), 246-52, 1991
Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440, Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite 12, Stellite 21, atomization, particle size, density, creep, metal injection molding

2. **HIP-Tool Materials**
Bayer, E.
Powder Metall Int 16 (3), 117-20, 1984 (AD-D130 130)
Key Words: Haynes 21, Stellite 6, tool steel, stainless steel, microstructure, impact toughness, tensile properties, net shape forming

3. **Metallography of Hot Isostatically Pressed Materials (Part 2)**
Piske, D., Wittner, I.
Pract Metall 21 (3), 107-17, 1984 (AD-D130 404)
Key Words: Ti-6Al-4V, Stellite 6, WC coating, diffusion welding, diffusion bonding

4. **Application Fields of the HIP-Technology**
Selistorfer, H.
Powder Metall Int 16 (6), 268-71, 1984 (AD-D131 767)
Key Words: Waspaloy, Udimet 700, Stellite 6, turbine components, net shape forming, mechanical properties, hardness

5. **Containerless HIPing of PM Parts: Technology Economics and Equipment Productivity**
Nyce, A. C.
Met Powder Rept 38 (7), 387-92, 1983 (AD-D128 150)
Key Words: AISI 4650, M-2, AISI 316L, Ti-6Al-4V, Monel 400, Stellite 6, Stellite 21, applications, cost, density, tensile properties

6. **New Approach Widens the Use of HIP P/M**
Precis Met 40 (10), 32-4, 1982 (AD-D128 141)
Key Words: AISI 4650, Stellite 6, AISI 316, Ti-6Al-4V, porosity, cost, tensile properties

7. **Trends in Powder Metallurgy Technology**
Chandler, H. E., Baxter, D. F.
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Key Words: RENE' 95, AISI 316, M-2, Stellite 6, Ti-6Al-4V, AISI 410, jet engines, net shape forming

X-40

1. **Superalloys from Powder: Production and Properties**
Author Anon
National Materials Advisory Board (NAS-NAE), Washington DC
Final Report
Rept No : NMAB-369, 102 pp., 1981 (AD-B058 349L)
Key Words: RENE' 95, X-40, Maraging 300, turbine components, fatigue, rapid solidification, mechanical properties, atomization

2. **Grain Size Control in PM Superalloys**
Dahlen, M.
NTIS, N79-18021, Springfield, VA
Final Report
Rept No : N79-18021, 31 pp., 1977 (AD-D115 659)
Key Words: Udimet 700, IN-738, X-40, grain size, tensile properties, creep properties, hardness, fatigue, recrystallization, annealing

3. **Hot Workability of Cobalt-Base Superalloys Produced via Powder Metallurgy**
Hellner, L., Johansson, H.
Powder Metall Int 8 (2), 82-6, 1976 (AD-D107 172)
Key Words: X-40, MAR-M509, superplasticity, hot working microstructure, cracking, tensile properties, temperature effect

4. **Study of Superalloys Produced via Powder Metallurgy**
Hellner, L., Johansson, H.
NTIS, N77-13210, Springfield, VA
Rept No : N77-13210, 56 pp., 1975 (AD-D109 492)
Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking, microstructure, temperature effect, deformation, stress intensity, tensile properties

5. **Modern Methods of Powder Metallurgical Processing of Superalloys**
Gessinger, G. H., Bomford, M. J.
Brown, Boveri & Co. Ltd., Baden, Switzerland
Proc Symp High Temperature Materials in Gas Turbines 35 pp., 1973 (AD-D102 997)
Key Words: Udimet 500, Hastelloy X, X-45, Udimet 710, IN-100, IN-853 Udimet 700, RENE' 95, Inconel 718, D-979, Nimonic 80A, TD-nickel, turbine components, creep rupture, tensile properties, fatigue, atomization, REP, thermomechanical treatment

6. **Specialty Methods of Powder Atomization**
Grant, N. J.
Massachusetts Institute of Technology, Cambridge, MA
Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center, Raquette Lake, NY, Aug-Sept 71, 13 pp., 1971 (AD-181 533)
Key Words: IN-100, Maraging 300, 18/8 stainless, AA 2024, X-45, AISI 316, REP, microstructure, ultrasonic testing, fatigue, tensile properties

7. **Coarse Powder Techniques**
Widmer, R., Industrial Materials Technology Inc., Woburn, MA
Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center, Raquette Lake, NY, Aug-Sept 71, 16 pp., 1971 (AD-181 534)
Key Words: IN-100, Maraging 300, X-45, MAR-M509, Hastelloy X, Udimet 710, Alloy 713, Ti-6Al-6V-2Sn, microstructure, creep rupture, tensile properties

Miscellaneous Cobalt Alloys

1. **Fully dense HIP compaction of mechanically alloyed amorphous powders**
Hiroshi, K., Toda, K., Yuine, T., Elsevier, London, UK
Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl. 223-8, 1992
Key Words: Co(79.5)Nb(15)Zr(5.5), compaction, density, viscous flow, porosity

2. **The Production and Processing of High-Quality Powder Metallurgy Materials**
Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W.
Powder Metall Int 23 (4), 246-52, 1991
Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440, Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite 12, Stellite 21, atomization, particle size, density, creep, metal injection molding

3. **Properties of 'Stellite' (R) Alloy No. 21 Made Via Pliable Powder Technology**
Aizaz, A., Kumar, P.
Metal Powder Industries Federation, Princeton, NJ
Proc Int Powder Metallurgy Conf, Modern Developments in Powder Metallurgy
16, 675-93, 1985 (AD-D138 355)
Key Words: Stellite 21, microstructure, Ceracon processing, fatigue, tensile properties

4. **A Comparison of the Fatigue Properties of Cast Wrought and HIP P/M Cobalt-Chromium Prosthetic Alloys**
Runkle, J. C., Nicholson, J., Rice, J.
Metal Powder Industries Federation, Princeton, NJ
Proc Int Powder Metallurgy Conf, Modern Developments in Powder Metallurgy
16, 705-25, 1985 (AD-D138 356)
Key Words: PREP, F-75, tensile properties, fatigue stress

5. **HIP-Tool Materials**
Bayer, F.
Powder Metall Int 16 (3), 117-20, 1984 (AD-D130 130)
Key Words: Haynes 21, Stellite 6, tool steel, stainless steel, microstructure, impact toughness, tensile properties, net shape forming

6. **Containerless HIPing of PM Parts: Technology Economics and Equipment Productivity**
Nyce, A. C.
Met Powder Rept 38 (7), 387-92, 1983 (AD-D128 150)
Key Words: AISI 4650, M-2, AISI 316L, Ti-6Al-4V, Monel 400, Stellite 6, Stellite 21, applications, cost, density, tensile properties

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Patterson, R. J.
United Technologies Corp., West Palm Beach, FL
Quarterly Report
Rept No : FR-8062, 22 pp., 1976 (AD-D108 171)
Key Words: MAR-M200, IN-100 Co-20Cr, airfoils, tantalum addition, microstructure, particle size, atomization

8. **Effect of Autoclave Heat Treatments on the Mechanical Properties of the Prealloyed Powder Cobalt-Base Alloy HS-31**
Freche, J. C., Ashbrook, R. L.
National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Technical Note
Rept No : NASA-TN-D-7117, 22 pp., 1973 (AD-181 092)
Key Words: HS-31, microstructure, heat treatment, creep rupture, tensile properties

IRON ALLOYS

A-286

1. **Characterization of a Rapidly Solidified Iron-Based Superalloy**
   Smugeresky, J. E.
   Metall Trans 13A (9), 1535-46, 1982 (AD-D125 578)
   Key Words: A-286, JBK-75, Fe-30Ni, microstructure, tensile properties, morphology

2. **Physical Metallurgy and Effects of Process Variables on the Microstructure of Wrought Superalloys**
   Muzyka, D. R.
   ASTM, Philadelphia, PA
   Proc Symp MiCon 78, 526-46, 1979 (AD-D126 409)
   Key Words: A-286, Incoloy 901, Inconel 718, Waspaloy, RENE' 95, Pyromet CTX-1, Pyromet 31, tensile properties, creep rupture, microstructure

3. **Microstructure and Properties of Hot Isostatically Pressed A-286**
   Smugeresky, J. E., German, R. M.
   Metall Trans 9A (2), 253-9, 1978 (AD-D111 960)
   Key Words: A-286, microstructure, tensile properties, brittle fracture intergranular fracture, carbide precipitation, titanium carbides

4. **Fracture Path in Hot Isostatically Pressed Superalloy A286**
   German, R. M., Smugeresky, J. E., Karfs, C. W.
   Powder Metall Int 9 (4), 178-9, 1977 (AD-D111 621)
   Key Words: A-286, intergranular fracture, fracture surface, titanium carbides, grain boundaries

5. **The Consolidation and Properties of Hot Isostatically Pressed A286 Stainless Steel**
   German, R. M., Smugeresky, J. E.
   J Met 28 (12), p. A51, 1976 (AD-D110 121)
   Key Words: A-286, tensile properties, fracture surface, aging

AISI 316

1. **HIP of Bi-modal Powder Mixtures: Modeling and Experiment**
   Funkenbusch, P. D., Li, E. K. H.
   Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl 17-22, 1992
   Key Words: AISI 316L, powder metallurgy, particle size optimization

2. **The Production and Processing of High-Quality Powder Metallurgy Materials**
   Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W.
   Powder Metall Int 23 (4), 246-52, 1991
   Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440, Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite 12, Stellite 21, atomization, particle size, density, creep, metal injection molding

3. **Deposition and Determination of Argon in HIP-Parts**
Stover, D., Buchkremer, H.P., Diehl, W., Kaiser, H., Laakmann, J.
MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
Proc Int Conf PM Aerospace Materials-87 8.1-8.9, 1988 (AD-D143 660)
Key Words: Udimet 700, AISI 316L, Hastelloy X, SEM, microscopy, porosity

4. **Advanced Processing and Properties of High-Performance Alloys**
Koss, D. A.
Department of Metallurgical Engineering, Michigan Tech University, Houghton
Technical Report Number Four
Contract No : N00014-85-K-0427
19 pp., 1986 (AD-A167 404)
Key Words: Ti-6Al-4V, AA 7075-T6, AA 1100, AISI 316, fabrication, rapid solidification

5. **Progress of Powder Metallurgy in North America**
Roll, K.H., Johnson, P.K.
Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

6. **Containerless HIPing of PM Parts: Technology Economics and Equipment Productivity**
Nyce, A. C.
Met Powder Rept 38 (7), 387-92, 1983 (AD-D128 150)
Key Words: AISI 4650, M-2, AISI 316L, Ti-6Al-4V, Monel 400, Stellite 6, Stellite 21, applications, cost, density, tensile properties

7. **Superalloys More Super Than Ever**
McIntyre, R. D.
Mater Eng 95 (1), 36-43, 1982 (AD-D124 025)
Key Words: RENE' 95, IN-100, AISI 316, microstructure, recrystallization, creep rupture, oxidation, tensile properties

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Precis Met 40 (10), 32-4, 1982 (AD-D128 141)
Key Words: AISI 4650, Stellite 6, AISI 316, Ti-6Al-4V, porosity, cost, tensile properties

9. **Trends in Powder Metallurgy Technology**
Chandler, H. E., Baxter, D. F.
Metal Prog 117 (1), 100-3, 1980 (AD-D117 225)
Key Words: RENE' 95, AISI 316, M-2, Stellite 6, Ti-6Al-4V, AISI 410, jet engines, net shape forming

10. **Corrosion Behavior of P/M and Conventionally made 316-L Stainless Steel**
Nazmy, M. Y., Karner, W., Al-Gwaiz, A. A.
J Met 30 (6), 14-9, 1978 (AD-D112 730)
Key Words: AISI 316L, corrosion, pitting, microstructure

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Jaffee, R. I.
Standardization News 5 (1), 9-22, 1977 (AD-D108 834)
Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement, fracture mechanics

12. **Specialty Methods of Powder Atomization**
Grant, N. J.
Massachusetts Institute of Technology, Cambridge, MA
Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center, Raquette Lake, NY, Aug-Sept 71
13 pp., 1971 (AD-181 533)
Key Words: IN-100, Maraging 300, 18/8 stainless, AA 2024, X-45, AISI 316, REP, microstructure, ultrasonic testing, fatigue, tensile properties

AISI 4340

1. **P/M Processing of the Rare Earth Modified High Strength Steels**
Sheinker, A. A.
TRW Inc., Materials Technology, Cleveland, OH
Rept No : TRW-ER-8097-2, 68 pp., 1980 (AD-A094 185)
Key Words: AISI 4340, rare earth addition, tensile properties, Charpy impact

2. **Application of Superplastic Steels**
Slaughter, E. R., Bourdeau, R. G.
Pratt and Whitney Aircraft Group, West Palm Beach, FL
Rept No : FR-10233, 20 pp., 1978 (AD-D108 306)
Key Words: AISI 4340, airfoils, aluminum addition, titanium addition, boron addition, tensile properties, superplasticity, thermomechanical treatment

3. **Hot Isostatic Pressing: An Economic Route to Powder Components**
James, P. J.
Metals and Materials 27-31, 1977 (AD-D111 600)
Key Words: AISI 4340, beryllium, Ti-6Al-4V, pressure vessels

4. **A Method for Specifying Hot Isostatic Pressure Welding Parameters**
Bryant, W. A.
Weld J 54 (12), 433-S-435-S, 1975 (AD-D102 316)
Key Words: AISI 4340, MAR-M250, AISI 1020, 9Ni-4Co steel, Inconel 718, diffusion welding, dissimilar joining, temperature effect, modulus of elasticity, melting point

M-2

1. **Mechanical Properties of PH-HIPed M2 high speed steel(HSS)**
Kothari, N. C.
Diffus Defect Data, Pt B 25-26, 471-8, 1992
Key Words: M-2, vanadium addition, austenitizing, tempering, mechanical properties, impact strength, bend strength, hardness

2. **Progress of Powder Metallurgy in North America**
Roll, K.H., Johnson, P.K.
Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

3. **Containerless HIPing of PM Parts: Technology Economics and Equipment Productivity**
Nyce, A. C.
Met Powder Rept 38 (7), 387-92, 1983 (AD-D128 150)
Key Words: AISI 4650, M-2, AISI 316L, Ti-6Al-4V, Monel 400, Stellite 6, Stellite 21, applications, cost, density, tensile properties

4. **Hot Isostatic Processing**
Clauer, A. H., Meiners, K. E, Boyer, C. B.
Metals Information Analysis Center, West Lafayette, IN
Rept No : MCIC-82-46, 228 pp., 1982 (AD-A132 232)
Key Words: Ti-6Al-4V, IN-738, RENE' 95, Udimet 700, IN-792 Inconel 718, M-1, M-2, B-1900, MAR-M250, welding, fatigue, tensile properties, heat treatment

5. **Properties of High-Speed Steels Produced by Powder Metallurgy**
Takigawa, H., Manto, H., Kawai, N., Homma, K.
Powder Metall 24 (4), 196-202, 1981 (AD-D122 928)
Key Words: M-2, M-3, M-35, M-36, AISI 1050, AISI 1040, AISI 321, AMS 6512, cutting tools, density, bend strength, toughness, cost

6. **Trends in Powder Metallurgy Technology**
Chandler, H. E., Baxter, D. F.
Metal Prog 117 (1), 100-3, 1980 (AD-D117 225)
Key Words: RENE' 95, AISI 316, M-2, Stellite 6, Ti-6Al-4V, AISI 410, jet engines, net shape forming

7. **The P/M Extrusion of Tool Steel Bar**
Dunkley, J. J., Causton, R. J.
Int J Powder Metall Powder Technol 13 (1), 13-20, 1977 (AD-D108 864)
Key Words: HSS, M-2, alloying, microstructure, hardness, impact properties, grinding, drilling, milling, cost, annealing, extrusion

8. **Toughness and Toughness Behavior of Two High-Speed Steels**
Berry, G., Kadhim Al-Tornachi, M. J.
Met Technol 4 (6), 289-95, 1977 (AD-D110 293)
Key Words: M-2, M-3, fracture toughness, fatigue, crack growth fracture mechanics, hardness, milling, tool life

9. **Crucible CPM Rex-High Speed Steel for Superior Cutting Tools**
Colt Industries Inc., N.Y., 5 pp., 1974 (AD-D104 321)
Key Words: M-1, M-2, M-7, M-10, M-42, M-3, T-15, H41, cutting tools, tool life, Charpy impact, impact toughness, wear, grain size

MA 956

1. **Materials for Advanced Turbine Engine--MATE**
Evans, D. J., Sheffler, K. D., Friedrich, L. A.
Pratt and Whitney Aircraft Group, East Hartford, CT
Quarterly Technical Progress Report Number Twenty Four, Dec 81-Feb.82
Contract No : NAS 3-20072
44 pp., 1982 (AD-D124 466)
Key Words: MERL 76, Hastelloy X, Incoloy 901, AMS 5616, AMS 4928, MA956, JT-9D, JT-8D, turbine components, coatings, erosion, fatigue

2. **Materials for Advanced Turbine Engine-MATE**
Evans, D. J., Sheffler, K. D., Friedrich, L. A.
Pratt and Whitney Aircraft Group, East Hartford, CT
Quarterly Technical Progress Report Number Twenty Two, Jun.-Aug. 1981
Contract No : NAS 3-20072
36 pp., 1981 (AD-D122 325)
Key Words: Hastelloy X, MA956, Udimet 700, MERL 76, turbine components, combustor liners, airfoils, coatings, fatigue, erosion resistance

3. **Materials for Advanced Turbine Engine-MATE**
Evans, D. J., Henricks, R. J., Friedrich, L. A., Blecherman, S. S.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Technical Progress Report Number Sixteen, Dec 79-Feb-80
Contract No : NAS3-20072
44 pp., 1980 (AD-D118 687)
Key Words: MERL 76, Haynes 8077, MA956, turbine components, combustor liners, tensile properties, creep rupture, coatings, plasma deposition, dispersion hardening

4. **Materials for Advanced Turbine Engine-MATE**
Evans, D. J., Henricks, R. J., Friedrich, L. A.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Technical Progress Report Number Seventeen, 1 Mar-31 May 1980
Contract No : NAS 3-20072
64 pp., 1980 (AD-D118 782)
Key Words: MERL 76, Haynes 8077, MA956, turbine components, combustor liners, compressor components, airfoils, fatigue, creep properties, coatings, mechanical properties

5. **Materials for Advanced Turbine Engine-MATE**
Evans, D. J., Henricks, R. J., Friedrich, L. A.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Technical Progress Report Number Eighteen, 1 Jun-31 Aug 1980
Contract No : NAS 3-20072
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Key Words: MERL 76, MA956, Hastelloy X, turbine components, tensile properties, fatigue, coatings

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Evans, D. J., Henricks, R. J., Friedrich, L. A.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Technical Progress Report Number nineteen, 1 Sept-30 Nov 1980
Contract No : NAS 3-20072
35 pp., 1980 (AD-D120 344)
Key Words: MERL 76, Haynes 8077, MA956, aircraft engines, turbine components, combustor liners, compressor components, airfoils, fatigue, net shape forming, coatings

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Evans, D. J., Gell, M.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Progress Report Number Thirteen
Contract No : NAS3-20072
47 pp., 1979 (AD-D.:6 198)
Key Words: Haynes 8077, MA956, MERL 76, turbine components, combustor liners, tensile properties, creep properties, dispersion hardening

8. **Powder Metallurgy Techniques Applied to Superalloys**
Benjamin, J. S., Larson, J. M.
J Aircr 14 (7), 613-23, 1977 (AD-D109 882)
Key Words: Udimet 700, RENE' 95, MA956E, MA754 turbine components, creep rupture, hot corrosion, oxidation, grain size, thermomechanical treatment

MAR-M250

1. **Microstructures and Mechanical Properties of HIP Consolidated 18% Ni Maraging Steel**
Komatsubara, N., Hayzelden, C., Cantor, B.
Powder Metall 30 (2), 119-24, 1987 (AD-D137 558)
Key Words: MAR-M250, microstructure, fracture, atomization, tensile properties

2. **Hot Isostatic Processing**
Clauer, A. H., Meiners, K. E, Boyer, C. B.
Metals Information Analysis Center, West Lafayette, IN
Rept No : MCIC-82-46, 228 pp., 1982 (AD-A132 232)
Key Words: Ti-6Al-4V, IN-738, RENE' 95, Udimet 700, IN-792, Inconel 718, M-1, M-2, B-1900, MAR-M250, welding, fatigue, tensile properties, heat treatment

3. **Ductility in Hot Isostatically Pressed 250-Grade Maraging Steel**
German, R. M., Smugeresky, J. E.
Metall Trans A 9A (3), 405-12, 1978 (AD-D112 162)
Key Words: MAR-M250, tensile properties, microstructure fracture surface, fabrication

4. **Effect of Hot Isostatic Pressing Temperature on the Properties of Inert Gas Atomized Maraging Steel**
German, R. M., Smugeresky, J. E.
Mater Sci Eng 36 (2), 223-30, 1978 (AD-D114 558)
Key Words: Maraging(250), microstructure, particle size, tensile properties, temperature effect

5. **A Method for Specifying Hot Isostatic Pressure Welding Parameters**
Bryant, W. A.
Weld J 54 (12), 433-S-435-S, 1975 (AD-D102 316)
Key Words: AISI 4340, MAR-M250, AISI 1020, 9Ni-4Co steel, Inconel 718, diffusion welding, dissimilar joining, temperature effect, modulus of elasticity, melting point

Maraging 300

1. **Superalloys from Powder: Production and Properties**
Author Anon
National Materials Advisory Board (NAS-NAE), Washington DC
Rept No : NMAB-369, 102 pp., 1981 (AD-B058 349L)
Key Words: RENE' 95, X-40, Maraging 300, turbine components, fatigue, rapid solidification, mechanical properties, atomization

2. **Soviet Activities in Iron and Titanium Powder Metallurgy**
Marley, W. F., Jr.
Metal Powder Industries Federation, Princeton, NJ
P/M Ordnance Seminar, Powder Metallurgy in Defense Technology
5 pp., 1978 (AD-D116 028)
Key Words: Maraging 300, titanium alloys, shock loading, dispersion hardening, thermomechanical treatment

3. **Properties of Maraging Steel 300 Produced by Powder Metallurgy**
Van Swam, L. F., Pelloux, R. M., Grant, N. J.
Powder Metall 17 (33), 33-45, 1974 (AD-D100 184)
Key Words: Maraging 300, tensile properties, fatigue, aging, annealing

4. **Structure and Property Control through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Final Technical Report
Contract No : DAHC15-70-C-0283
411 pp., 1973 (AD-775 225)
Key Words: AA 7075, AA 2024, AISI 1045, IN-100, MAR-M509, Maraging 300, tensile properties

5. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Regis, M. N., Flemings, M. C., Merton, C.
Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Semi-Annual Technical Report Number Three Jul-Dec 1971
Contract No : DAHC15-70-C-0283
130 pp., 1972 (AD-739 340)
Key Words: IN-100, MAR-M509, Maraging 300, microstructure, tensile properties, fatigue, hardness, creep rupture, fracture toughness

6. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Semi-Annual Technical Report Number Four, Jan-Jul 1972
Contract No : DAHC15-70-C-0283
140 pp., 1972 (AD-749 679)
Key Words: AA 7075, IN-100, MAR-M509, AISI 1045, Maraging 300, microstructure, fractography, tensile properties

7. **Specialty Methods of Powder Atomization**
Grant, N. J.
Massachusetts Institute of Technology, Cambridge, MA
Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center, Raquette Lake, NY, Aug-Sept 71
13 pp., 1971 (AD-181 533)
Key Words: IN-100, Maraging 300, 18/8 stainless, AA 2024, X-45, AISI 316, REP, microstructure, ultrasonic testing, fatigue, tensile properties

8. **Coarse Powder Techniques**
Widmer, R.
Industrial Materials Technology Inc., Woburn, MA
Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center, Raquette Lake, NY, Aug-Sept 71
16 pp., 1971 (AD-181 534)
Key Words: IN-100, Maraging 300, X-45, MAR-M509, Hastelloy X, Udimet 710, Alloy 713, Ti-6Al-6V-2Sn, microstructure, creep rupture, tensile properties

9. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Regis, M. N., Flemings, M. C., Merton, C. Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Semi-Annual Technical Report Number Two Jan-Jun 1971
Contract No : DAHC15-70-C-0283
191 pp., 1971 (AD-728 053)
Key Words: IN-100, Vascomax 300, MAR-M509, extrusion, tensile properties, creep rupture, quenching

T-15

1. **The Production and Processing of High-Quality Powder Metallurgy Materials**
Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W.
Powder Metall Int 23 (4), 246-52, 1991
Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440, Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite 12, Stellite 21, atomization, particle size, density, creep, metal injection molding

2. **Powder Metallurgy T15 Tool Steel: Part I. Characterization of Powder and Hot Isostatically Pressed Material**
Kumar, K. S., Lawley, A., Koczak, M. J.
TMS, Warrendale, PA
Contract No : N00014-84-K-0472
Metall Trans A 22A, 2733-45, 1991
Key Words: T-15, microstructure, atomization, carbides, lattice parameters, hardness, particle size

3. **Powder Metallurgy T15 Tool Steel: Part II. Microstructure and Properties After Heat Treatment**
Kumar, K. S., Lawley, A., Koczak, M. J.
Metall Trans A 22A, 2747-59, 1991
Key Words: T-15, particle size, heat treatment, microstructure, atomization, grain growth, carbides, impact toughness, bend strength, fracture surface, crack initiation, hardness

4. **Processing Variables and Failure Properties of Water Atomised Sintered T15 High-Speed Steels**
Santos, M., Gomes, M., Oliveira, M. M., Rebbeck, M. M., Wronski, A. S.
PM Into the 1990's 2, 155-8, 1990
Key Words: T-15, HSS, water atomization, sintering, transverse rupture strength, grain boundaries, brittle fracture, fracture toughness, microstructure

5. **Influence of HIP after Sintering on Fracture Toughness of High Speed Steels**
Martinez, V., Palma, R.H., Urcola, J.J.
Met Powder Rept 44 (11), 751-4, 1989 (AD-D142 698)
Key Words: T-6, T-15, microscopy, high speed steel, sintering, fracture toughness, hardness

6. **A Fundamental Study of Tool Steels Processed from Rapidly Solidified Powders**
Lawley, A., Koczak, M. J.
Drexel University, Department of Materials Engineering, Philadelphia, PA
Annual Report
Contract No : N00014-81-K-0039
101 pp., 1983 (AD-A126 163)
Key Words: T-15, Rex 25, tool steel, microstructure, hardness, size distribution

7. **Microstructure and Properties of P/M Tool Steels**
Kumar, S., Fareed, A., Koczak, M. J., Lawley, A.
Drexel University, Department of Materials Engineering, Philadelphia, PA
Technical Report
Contract No : N00014-81-K-0039
29 pp., 1983 (AD-A130 980)
Key Words: T-15, Rex 25, tool steel, microscopy, austenitizing, bend strength, impact toughness, diffraction

8. **Evaluation of Powder Processed Turbine Engine Ball Bearings**
Brown, Paul F., Bogardus, Glen A., Miner, J. R.
Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
Final Report
Rept No : PWA-FR-12981, 76 pp., 1981 (AD-A103 263)
Key Words: M-50, T-15, CRB-7, turbine components, microstructure, fatigue, corrosion

9. **A Fundamental Study of Tool Steels Processed from Rapidly Solidified Powders**
Lawley, A., Koczak, M. J.
Drexel University, Department of Materials Engineering, Philadelphia, PA
Annual Report
Contract No : N00014-81-K-0039
55 pp., 1981 (AD-A112 758)
Key Words: T-15, Rex 25, 4Cr steel, particle size, lattice parameters

10. **Hot Isostatic Pressing Favorably Influences Heat Treatment and Performance of P/M Tool Steels**
Lasday, S. B.
Ind Heat 44 (5), 12-5, 1977 (AD-D109 624)
Key Words: HSS, T-15, M-4, M-35S, CPM Rex76, microstructure, grain size, carbide precipitation, hardness, tooling

11. **Crucible CPM Rex-High Speed Steel for Superior Cutting Tools**
Colt Industries Inc., N.Y.
5 pp., 1974 (AD-D104 321)
Key Words: M-1, M-2, M-7, M-10, M-42, M-3, T-15, H41, cutting tools, tool life, Charpy impact, impact toughness, wear, grain size

Miscellaneous Stainless Steel

1. **The Production and Processing of High-Quality Powder Metallurgy Materials**
   Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W.
   Powder Metall Int 23 (4), 246-52, 1991
   Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440, Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite 12, Stellite 21, atomization, particle size, density, creep, metal injection molding

2. **Influence of Powder Surface Oxidation on Some Properties of HIPed Martensitic Chromium Steel**
   Arnberg, L., Karlsson, A.
   Int J Powder Metall 24 (2), 107-12, 1988 (AD-D138 728)
   Key Words: 12Cr-1Mo steel, microstructure, fracture, impact, hardening, atomization, tensile properties

3. **Performance Test of 110 mm Bore Ball Bearing Made from Corrosion Resistant Powdered Steel**
   Munson, H. E.
   Geo Centers Inc., Newton Centre, MA
   Final Technical Report
   Contract No : F33615-84-C-2412
   40 pp., 1986 (AD-A177 060)
   Key Words: MRC2001, 15Cr stainless, ball bearings, jet engines, corrosion, fatigue tests, residual stress, compressive stress

4. **HIPing of Stainless Steel--A New Technique for the Offshore Industry**
   Andersson, T.
   Met Powder Rept 40 (3), 164-7, 1985 (AD-D132 556)
   Key Words: 20Cr-18Ni, 26Cr stainless, 20Cr-25Ni, grain size, corrosion, tensile properties, fatigue, impact

5. **HIP-Tool Materials**
   Bayer, E.
   Powder Metall Int 16 (3), 117-20, 1984 (AD-D130 130)
   Key Words: Haynes 21, Stellite 6, tool steel, stainless steel, microstructure, impact toughness, tensile properties, net shape forming

6. **Processing and Consolidation of Rapidly Solidified Alloys: A Technology Assessment**
   Flinn, J. E.
   EG & G Idaho Inc., Idaho Falls, ID
   Technical Report
   Rept No : EGG-SCM-6595, 123 pp., 1984 (AD-D132 399)
   Key Words: stainless steel, alloy development, rapid solidification, scaling, atomization

7. **Injection Molding of 17-4 PH Stainless Steel**
   Marshall, T. P.
   Hughes Aircraft Co., Canoga Park, CA
   Technical Paper
   Rept No : SAE-841516, 28 pp., 1984 (AD-D133 738)
   Key Words: 17-4PH, metallography, Charpy impact, fatigue, tensile properties, injection molding

8. **Rapid Solidification of Metallic Particulates**
Grant, N. J.
Massachusetts Institute of Technology, Department of Materials Science and Engineering, Cambridge, MA
Contractor Report
Rept No : NASA-CR-169070, 16 pp., 1982 (AD-D126 287)
Key Words: Udimet 700, AA 7075, stainless steel, maraging steel, tensile properties, microstructure, splat quenching

9. **Some Recent Developments in Powder Metallurgy**
Haynes, R.
Metallurgist and Materials Technologist 13 (7), 355-60, 1981 (AD-D121 844)
Key Words: 1Mn steel, EN 16, 1Ni steel, Distaloy, tensile properties, impact, hardness

10. **Wrought Fe-Cr-Al Alloys**
Dzneladze, Zh. I., Lykova, V. F., Shchegoleva, R. P., Bakalinskii, V. G. Kiselev, A. A.
Sov Powder Metall Met Ceram 20 (5), 343-50, 1981 (AD-D122 798)
Key Words: 10Cr steel, 15Cr stainless, 20Cr stainless, 25Cr stainless, Fe-10Al, microstructure, grain size, oxidation, annealing, tensile properties

11. **Properties of High-Speed Steels Produced by Powder Metallurgy**
Takigawa, H., Manto, H., Kawai, N., Homma, K.
Powder Metall 24 (4), 196-202, 1981 (AD-D122 928)
Key Words: M-2, M-3, M-35, M-36, AISI 1050, AISI 1040, AISI 321, AMS 6512, cutting tools, density, bend strength, toughness, cost

12. **Trends in Powder Metallurgy Technology**
Chandler, H. E., Baxter, D. F.
Metal Prog 117 (1), 100-3, 1980 (AD-D117 225)
Key Words: RENE' 95, AISI 316, M-2, Stellite 6, Ti-6Al-4V, AISI 410, jet engines, net shape forming

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Irving, R. R.
Iron Age 223 (28), 41-5, 1980 (AD-D118 875)
Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

14. **Medium and High Alloy P.M. Steel Products by Hot Isostatic Pressing**
Garvare, T., Benning, C.
Metall 47 (1), 33-7, 1980 (AD-D119 452)
Key Words: 3Cr steel, 3.5Ni steel, 12Cr steel, impact properties creep rupture, tensile properties, hardness, net shape forming

15. **Basic Trends in Advanced Fabrication Processes**
Walther, H. H.
Fiat S P A Turin (Italy) Laboratori Centrali Orbassano
Proc 47th Meeting of the AGARD Structures and Materials Panel, Advanced Fabrication Processes
Rept No : AGARD-CP-256, K-1 to K-12, 1979 (AD-D117 178)
Key Words: AISI 1045, AISI 304, fabrication, welding, machining, superplastic forming, ion implantation, net shape forming, coatings

16. **Evaluation of Powder Processed Turbine Engine Ball Bearings**
Brown, P. F., Potts, J. R.
Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
Interim Report
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NICKEL ALLOYS

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Key Words: IN-100, Maraging 300, X-45, MAR-M509, Hastelloy X, Udimet 710, Alloy 713, Ti-6Al-6V-2Sn, microstructure, creep rupture, tensile properties

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22. **Cost 50: Materials for Gas Turbines**
Bunk, W., Hansen, J.
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Key Words: IN-738LC, IN-939, IN-597, IN-100, Alloy 713LC, Nimonic 105, Udimet 520, Udimet 700, turbine components, welding, cyclic fatigue, coatings, corrosion, creep

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Key Words: MAR-M200, IN-100, 7Ni steel, 9Ni steel, turbine components, airfoils, rapid solidification, atomization, recrystallization, thermal stability

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Key Words: IN-100, IN-738, Alloy 713, Inconel 718, RENE' 95, Ti-6Al-4V, Waspaloy, precipitation hardening

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Key Words: IN-100, Udimet 700, turbine components, fabrication, gatorizing, ultrasonic testing

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Key Words: MAR-M200, IN-100, Co-20Cr, airfoils, tantalum addition, microstructure, particle size, atomization

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Key Words: IN-100, microstructure, recrystallization, grain size, precipitation, creep rupture, tensile properties, fatigue, atomization, particle size, heat treatment

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Key Words: IN-100, Udimet 500, MAR-M246, Udimet 700, TD-nickel, chromium addition, porosity, cracking, creep rupture, grain growth, dispersion hardening, tensile properties, microstructure, hot corrosion, oxidation, thermomechanical treatment

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Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Contract No : DAHC15-70-C-0283,411 pp., 1973 (AD-775 225)
Key Words: AA 7075, AA 2024, AISI 1045, IN-100, MAR-M509, Maraging 300, tensile properties

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Proc Symp High Temperature Materials in Gas Turbines 35 pp., 1973 (AD-D102 997)
Key Words: Udimet 500, Hastelloy X, X-45, Udimet 710, IN-100, IN-853 Udimet 700, RENE' 95, Inconel 718, D-979, Nimonic 80A, TD-nickel, turbine components, creep rupture, tensile properties, fatigue, atomization, REP, thermomechanical treatment

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Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Contract No : DAHC15-70-C-0283, 130 pp., 1972 (AD-739 340)
Key Words: IN-100, MAR-M509, Maraging 300, microstructure, tensile properties, fatigue, hardness, creep rupture, fracture toughness

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Key Words: IN-738, FeCrAlY coatings, microstructure, epitaxial growth, electron beam melting, plasma deposition

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Kaieda, Y.
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Key Words: IN-738, MA6000, MA753, turbine components, creep rupture

3. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

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Key Words: Ti-6Al-4V, IN-738, RENE' 95, Udimet 700, IN-792, Inconel 718, M-1, M-2, B-1900, MAR-M250, welding, fatigue, tensile properties, heat treatment

6. **Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Hreneccin, D. E., Schilling, W. F., Ostergren, W. J.
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Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

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Key Words: T-111, Ti-6Al-4V, AA A356-T61, IN-738, RENE' 80, Udimet 700, IN-792, welding, tensile properties, pressure bonding

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Kramer, K-H.
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Dahlen, M.
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Key Words: Udimet 700, IN-738, X-40, grain size, tensile properties, creep properties, hardness, fatigue, recrystallization, annealing

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Sutcliffe, P. W.
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Rept No : AGARD-R-641, 14 pp., 1976 (AD-A028 348)
Key Words: IN-100, IN-738, Alloy 713, Inconel 718, RENE' 95, Ti-6Al-4V, Waspaloy, precipitation hardening

14. **Atomised Powder-The Key to New Alloys**
Wallis, P. B.
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Key Words: Nimonic 75, Nimonic 80A, Nimonic 81, Nimonic 90, Nimonic 105, Nimonic 115, Incoloy 901, Nimonic PE11, Nimonic PE16, Nimonic 263, Inconel 718, Inconel X-750, Nimocast 80, Nimocast 242, Nimocast 263, Alloy 713C, Alloy 713LC, Nimocast PD21, Nimocast PE10, Nimocast PK24, IN-738, turbine components

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Semchyshen, M.
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Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking, microstructure, temperature effect, deformation, stress intensity, tensile properties

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Hanes, H. D.
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Key Words: Ti-6Al-4V, IN-738, RENE' 77, IN-792, defects, diffusion bonding, elongation

IN-792

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Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

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Proc Int Powder Metallurgy Conf, Modern Developments in Powder Metallurgy 16, 635-73, 1985 (AD-D138 354)
Key Words: Udimet 700, AF-115, IN-792, MAR-M432, MERL 76, PA 101, RENE' 41, tensile properties, creep rupture, fatigue

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Key Words: Ti-6Al-4V, IN-738, RENE' 95, Udimet 700 IN-792, Inconel 718, M-1, M-2, B-1900, MAR-M250, welding, fatigue, tensile properties, heat treatment

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Key Words: AA 7010-T73651, Corona-5, AA A357-T6, IN-792, fatigue, bearing strength, tensile properties, thermal expansion

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Key Words: TRW NASA VI A, IN-100, IN-792, TAZ-8A, creep rupture, tensile properties, thermal fatigue

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Key Words: IN-792, IN-100, turbine components, creep, Larsen-Miller curves, fatigue, tensile properties, Charpy impact, thermal cycling, thermal shock

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Key Words: IN-792, turbine components, hafnium addition, microstructure, tensile properties, creep rupture, temperature effect, cost

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Clark, L. P.
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Key Words: IN-100, AA 7075-T6, IN-792, Ti-6Al-4V, turbine components, nondestructive testing

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Hanes, H. D.
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Key Words: Ti-6Al-4V, IN-738, RENE' 77, IN-792, defects, diffusion bonding, elongation

Incoloy 901

1. **Properties and Microstructures for Dual Alloy Combinations of Three Superalloys with Alloy 901**
   Harf, F. H.
   National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
   Technical Memorandum
   Rept No : NASA-TM-86987, 42 pp., 1985 (AD-D134 337)
   Key Words: Incoloy 901, RENE' 95, MERL 76, Udimet 700, turbine components, microstructure, tensile properties, creep rupture, joining

2. **Materials for Advanced Turbine Engine--MATE**
   Evans, D. J., Sheffler, K. D., Friedrich, L. A.
   Pratt and Whitney Aircraft Group, East Hartford, CT
   Quarterly Technical Progress Report Number Twenty Four, Dec 81-Feb.82
   Contract No : NAS 3-20072
   44 pp., 1982 (AD-D124 466)
   Key Words: MERL 76, Hastelloy X, Incoloy 901, AMS 5616, AMS 4928, MA956, JT-9D, JT-8D, turbine components, coatings, erosion, fatigue

3. **Mechanisms of Recovering Low Cycle Fatigue Damage in Incoloy 901**
   Schafrik, R. E.
   Air Force Inst of Tech, Wright-Patterson AFB, OH
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   Rept No : AFIT-CI-79-212D, 261 pp., 1979 (AD-A107 255)
   Key Words: Incoloy 901, crack propagation, rejuvenation, aging, metallography, fatigue, tensile properties

4. **Physical Metallurgy and Effects of Process Variables on the Microstructure of Wrought Superalloys**
   Muzyka, D. R.
   ASTM, Philadelphia, PA
   Proc Symp MiCon 78, 526-46, 1979 (AD-D126 409)
   Key Words: A-286, Incoloy 901, Inconel 718, Waspaloy, RENE' 95, Pyromet CTX-1, Pyromet 31, tensile properties, creep rupture, microstructure

5. **Production of Components by Hot Isostatic Pressing of Nickel-Base Superalloy Powders**
   Blackburn, M. J., Sprague, R. A.
   Met Technol 4 (8), 388-95, 1977 (AD-D110 796)
   Key Words: Incoloy 901, Waspaloy, Udimet 700, IN-100, turbine components, tensile properties, creep rupture, metallography

6. **Atomised Powder-The Key to New Alloys**
   Wallis, P. B.
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   Key Words: Nimonic 75, Nimonic 80A, Nimonic 81, Nimonic 90, Nimonic 105, Nimonic 115, Incoloy 901, Nimonic PE11, Nimonic PE16, Nimonic 263, Inconel 718, Inconel X-750, Nimocast 80, Nimocast 242, Nimocast 263, Alloy 713C, Alloy 713LC, Nimocast PD21, Nimocast PE10, Nimocast PK24, IN-738, turbine components

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1. **Relationship of Microstructure to Properties of HIP and Weld Clad Alloy 625 in Sour Environments**
   Sisak, W. J., Ayer, R., Mueller, R. R., Leta, D. P. , MS, Warrendale, PA
   Proc Int Symp Metall Appl Superalloys 718, 625 Var Deriv 803-20, 1991
   Key Words: Inconel 625, AISI 4130, 2.25Cr-1Mo steel, cladding, welding, corrosive medium, mechanical properties, microstructure, carbides

2. **Nickel Alloys by P/M**
   Birkholz, W.J., Stulga, J.E., Eisen, W.B., Moll, J.H.
   MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
   Proc Int Conf PM Aerospace Materials-87, 2.1-2.9, 1988 (AD-D143 657)
   Key Words: Udimet 700, Inconel 625, RENE' 95, H-13 tool steel, precipitation hardening, tensile properties, thermal expansion, hardness, creep

3. **The Metallurgy and Applications of Rapidly Solidified Alloy 625**
   Stulga, J. E., McTiernan, B. J.
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   Key Words: Inconel 625, atomization, rapid solidification, aging, tensile properties, hardness

4. **Metallurgical Evaluation of Cr Modified Cu-Ni and Inconel 625 Piping Made by Powder Metallurgy Methods**
   Palko, W. A.
   David W. Taylor Naval Ship Research and Development Center, Ship Materials Engineering Department, Annapolis, MD
   Rept No : DTNSRDC/SME-84-65, 47 pp., 1984 (AD-B088 715L)
   Key Words: Inconel 625, welding, hardness, grain size, corrosion, tensile properties

5. **Progress of Powder Metallurgy in North America**
   Roll, K.H., Johnson, P.K.
   Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
   Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

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   Vaccari, J. A.
   Amer Mach 127 (5), 121-36, 1983 (AD-D127 193)
   Key Words: AA 7090, AA 7091, IN9052, Ti-6Al-4V, Monel 400, Inconel 600, RENE' 95, Cb291, Udimet 700, IN-100, AF-115, Inconel 625, net shape forming, injection molding, applications, forging

Inconel 718

1. **Structure/Property Evaluation and Comparison between Shock-Wave Consolidated and Hot-Isostatically Pressed Compacts of RSP Pyromet 718 Alloy Powders**
   Thadhani, N. N., Mutz, A. H., Vreeland, T., Jr.
   Acta Metall 37 (3), 897-908, 1989 (AD-D140 991)
   Key Words: Pyromet 718, shock wave processing, impact tests, tensile properties, consolidation, rapid solidification

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Iwai, K., Furuta, S., Yokomaku, T.
Kobelco Technology Review 3, 6-10, 1988 (AD-D138 841)
Key Words: AF-115, Waspaloy, Inconel 718, turbine components, tensile properties, fatigue, cracking

3. **Production, Compaction and Application of Metal Powders**
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Key Words: 300M, Waspaloy, Inconel 718, AA 2218, AA 2219, AA 2618, AISI 52100, atomization, rapid solidification, tensile properties, net shape forming

4. **A Comparison Between Different Compounds for Improving the Corrosion Protection of FeCrAlY Coatings on Superalloys**
Burman, C., Ericsson, T., Kvernes, I., Lindblom, Y.
Surface and Coatings Technology 36 (1-2), 1-12, 1988 (AD-D140 581)
Key Words: Inconel 718, corrosion protection, TiN coatings, vacuum plasma spraying, oxidation

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Fiedler, H. C., Sawyer, T. F., Kopp, R. W., Leatham, A. G.
J Met 39 (8), 28-33, 1987 (AD-D137 356)
Key Words: RENE' 95, Inconel 718, near net forming, tensile properties, fatigue, creep rupture

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Mutz, A.H., Thadhani, N.N., Vreeland, T., Jr.
DGM Informationsgesellschaft mbH, Germany
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Key Words: Pyromet 718, Inconel 718, microscopy, tensile properties, shock loading, aging

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Michel, D. J., Smith, H. H.
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Key Words: Inconel 718, microstructure, tensile properties, hardness, creep rupture, fractography

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Bain, K. R., Pelloux, R. M.
Metall Trans 15A (2), 381-8, 1984 (AD-D129 273)
Key Words: RENE' 95, Inconel 718, IN-100, Inconel X-750, Udimet 700, creep, crack growth, fractography

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Clauer, A. H., Meiners, K. E. Boyer, C. B.
Metals Information Analysis Center, West Lafayette, IN
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Rept No : MCIC-82-46, 228 pp., 1982 (AD-A132 232)
Key Words: Ti-6Al-4V, IN-738, RENE' 95, Udimet 700, IN-792, Inconel 718, M-1, M-2, B-1900, MAR-M250, welding, fatigue, tensile properties, heat treatment

10. **Fatigue Growth of Surface Cracks in Nickel-Based Superalloys**
Brown, C. W., Hicks, M. A.
Int J Fatigue 4 (2), 73-81, 1982 (AD-D124 743)
Key Words: Inconel X-750, Inconel 718, turbine components, microstructure, grain size, crack growth, fatigue, tensile properties

11. **Physical Metallurgy and Effects of Process Variables on the Microstructure of Wrought Superalloys**
Muzyka, D. R.
ASTM, Philadelphia, PA
Proc Symp MiCon 78, 526-46, 1979 (AD-D126 409)
Key Words: A-286, Incoloy 901, Inconel 718, Waspaloy, RENE' 95, Pyromet CTX-1, Pyromet 31, tensile properties, creep rupture, microstructure

12. **Evaluation of Cyclic Behavior of Aircraft Turbine Disk Alloys**
Shahani, V., Popp, H. G.
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Rept No : N78-33478, 194 pp., 1978 (AD-D113 912)
Key Words: RENE' 95, Inconel 718, aircraft structures, turbine components, fatigue, fracture mechanics, crack growth, creep rupture, tensile properties

13. **Forging and Powder Metallurgy Processing**
Fischmeister, H., Straube, H.
Applied Sciences Publishers Ltd., London, UK
Proc Conf High Temperature Alloys for Gas Turbines, 769-816, 1978 (AD-D116 363)
Key Words: Nimonic 90, Udimet 520, Udimet 700, Inconel 718, IN-738, IN-100, turbine components, microstructure, creep properties, tensile properties, fatigue, precipitation, thermomechanical treatment

14. **Review of Advanced Powder Metallurgical Fabrication Techniques in European NATO Countries**
Sutcliffe, P. W.
Advisory Group for Aerospace Research and Development, Paris, France
Rept No : AGARD-R-641, 14 pp., 1976 (AD-A028 348)
Key Words: IN-100, IN-738, Alloy 713, Inconel 718, RENE' 95, Ti-6Al-4V, Waspaloy, precipitation hardening

15. **Materials for Advanced Turbine Engines-MATE**
Bamberger, E. N., Mosier, J. S.
General Electric Co., Aircraft Engine Group, Evendale, OH
Second Quarterly Engineering Report
Rept No : R76AEG345-1, 60 pp., 1976 (AD-D107 441)
Key Words: Inconel 718, RENE' 95, turbine components, nozzles, vanes, tensile properties, thermal cycling, heat treatment, aging

16. **Atomised Powder-The Key to New Alloys**
Wallis, P. B.
Powder Metall Int 8 (4), 167-9, 1976 (AD-D108 681)
Key Words: Nimonic 75, Nimonic 80A, Nimonic 81, Nimonic 90, Nimonic 105, Nimonic 115, Incoloy 901, Nimonic PE11, Nimonic PE16, Nimonic 263, Inconel 718, Inconel X-750, Nimocast 80, Nimocast 242, Nimocast 263, Alloy 713C, Alloy 713LC, Nimocast PD21, Nimocast PE10, Nimocast PK24, IN-738, turbine components

17. **Nickel Superalloy Powder Production and Fabrication to Turbine Discs**
Symonds, C. H., Thompson, F. A.
Wiggins (Henry) and Co. Ltd., Hereford, UK
Proc 42nd Meeting of the AGARD Structures and Materials Panel
p.3-1 to p.3-14, 1976 (AD-D110 181)
Key Words: Waspaloy, Nimonic 901, Inconel 718, turbine components, tensile properties, creep rupture, fatigue, notch properties, fabrication

18. **Processing: The Rediscovered Dimension in High Temperature Alloys**
Semchyshen, M., Standardization News 4 (4), 9-19, 1976 (AD-D110 676)
Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

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Bryant, W. A., Weld J 54 (12), 433-S-435-S, 1975 (AD-D102 316)
Key Words: AISI 4340, MAR-M250, AISI 1020, 9Ni-4Co steel, Inconel 718, diffusion welding, dissimilar joining, temperature effect, modulus of elasticity, melting point

20. **Modern Methods of Powder Metallurgical Processing of Superalloys**
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Proc Symp High Temperature Materials in Gas Turbines 35 pp., 1973 (AD-D1[illegible] 997)
Key Words: Udimet 500, Hastelloy X, X-45, Udimet 710, IN-100, IN-853 Udimet 700, RENE' 95, Inconel 718, D-979, Nimonic 80A, TD-nickel, turbine components, creep rupture, tensile properties, fatigue, atomization, REP, thermomechanical treatment

21. **Glass Bag Hot Isostatic Pressing of Superalloys**
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Key Words: Udimet 700, Inconel 718, IN-100, mechanical properties

MA6000

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Key Words: IN-738, MA6000, MA753, turbine components, creep rupture

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3. **The Effects of Small Deformation on Creep and Stress Rupture Behavior of ODS Superalloys**
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Key Words: Udimet 700, MA754, MA6000, oxide dispersoids, notch toughness, crack propagation, fatigue, creep deformation

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Lenel, F. V., Ansell, G. S., J Met 34 (2), 17-29, 1982 (AD-D124 400)
Key Words: beryllium, MAR-M200, Ti-6Al-4V, MA67, MA6000E, steel, tensile properties, sintering

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Proc 4th Int Symp Superalloys, Superalloys 1980, 563-73, 1980 (AD-D120 685)
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1. **Flow Behavior of Nickel-Base Superalloys at Isothermal Forging Temperatures and Strain Rates**
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Key Words: IN-100, MAR-M200, Alloy 713LC, grain size, deformation, flow properties

2. **Trends in Superalloy Powder Processing**
Immarigeon, J-P., Wallace, W.
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Key Words: Alloy 713LC, MAR-M200, microstructure, grain size, net shape forming

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Key Words: beryllium, MAR-M200, Ti-6Al-4V, MA67, MA6000E, steel, tensile properties, sintering

4. **Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Hrenecein, D. E., Schilling, W. F., Ostergren, W. J.
General Electric Co., Gas Turbine Division, Schenectady, NY
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 [illegible]4)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

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Gessinger, G. H.
Powder Metall Int 13 (2), 93-101, 1981 (AD-D122 017)
Key Words: MERL 76, Udimet 700, RENE' 95, IN-738, MA6000E, MAR-M200, mechanical properties, corrosion, superplastic forming, thermomechanical treatment

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Tien, J. K., Howson, T. E.
ASM International, Metals Park, OH
Proc 1981 ASM Materials Science Seminar, 155-87, 1981 (AD-D129 412)
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Key Words: MAR-M200, microhardness, aging, heat treatment, extrusion

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Cox, A. R., Moore, J. B., Van Reuth, E. C.
Pratt and Whitney Aircraft Group, West Palm Beach, FL
Proc 47th Meeting of the AGARD Structures and Materials Panel, Advanced Fabrication Processes
Rept No : AGARD-CP-256, 12-1 to 12-11, 1979 (AD-D117 187)
Key Words: MAR-M200, IN-100, tensile properties, creep properties, rapid solidification, recrystallization

9. **Forging Behavior of Superalloy Compacts and Composites**
Kandeil, A., Immarigeon, J-P., Wallace, W.
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Rept No : NRC-16543, 46 pp., 1978 (AD-D117 399)
Key Words: MAR-M200, compressive properties, fracture mechanics, particle size

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Cox, A. R.
United Technologies Corp., West Palm Beach, FL
Quarterly Report
Rept No : FR-8688, 24 pp., 1977 (AD-D108 239)
Key Words: MAR-M200, IN-100, 7Ni steel, 9Ni steel, turbine components, airfoils, rapid solidification, atomization, recrystallization, thermal stability

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Patterson, R. J.
United Technologies Corp., West Palm Beach, FL
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Rept No : FR-8062, 22 pp., 1976 (AD-D108 171)
Key Words: MAR-M200, IN-100, Co-20Cr, airfoils, tantalum addition, microstructure, particle size, atomization

12. **Control of Grain Structure during Superalloy Powder Processing**
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National Aeronautical Establishment, Ottawa, Canada
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Key Words: Alloy 713LC, MAR-M200, IN-100, MAR-M246, Udimet 700 microstructure, tensile properties, creep rupture, gamma prime, thermomechanical treatment, temperature effect

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   Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W
   Powder Metall Int 23 (4), 246-52, 1991
   Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440, Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite 12, Stellite 21, atomization, particle size, density, creep, metal injection molding

2. **Mechanical Properties of Powder Ni-Base Superalloy Consolidated by HIP**
   Takigawa, H., Iwai, K., Kawai, N., Kokomaku, T.
   J Jpn Soc Powder Powder Metall 33 (5), 251-6, 1986 (AD-D135 711)
   Key Words: MERL 76, IN-100, AF-115, creep rupture, tensile properties, fatigue

3. **Structure and Properties of a Rapidly Solidified Superalloy Produced by Liquid Dynamic Compaction**
   Ogata, K., Lavernia, E., Rai, G., Grant, N. J.
   Int J Rapid Solidif 2 (1), 21-35, 1986 (AD-D135 785)
   Key Words: MERL 76, IN-100, microstructure, tensile properties, rapid solidification

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   Morishita, M., Nagai, H., Shoji, K.
   J Jpn Soc Powder Powder Metall 33 (7), 373-8, 1986 (AD-D136 163)
   Key Words: IN-100, MERL 76, microstructure, swaging, creep rate, liquid sintering, creep rupture

5. **Properties and Microstructures for Dual Alloy Combinations of Three Superalloys with Alloy 901**
   Harf, F. H.
   National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
   Technical Memorandum
   Rept No : NASA-TM-86987, 42 pp., 1985 (AD-D134 337)
   Key Words: Incoloy 901, RENE' 95, MERL 76, Udimet 700, turbine components, microstructure, tensile properties, creep rupture, joining

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   Metal Powder Industries Federation, Princeton, NJ
   Proc Int Powder Metallurgy Conf, Modern Developments in Powder Metallurgy 16, 635-73, 1985 (AD-D138 354)
   Key Words: Udimet 700, AF-115, IN-792, MAR-M432, MERL 76, PA 101, RENE' 41, tensile properties, creep rupture, fatigue

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   Key Words: AA 2219-T851, Udimet 700, MERL 76, IN-100, RENE' 95, creep, cracking, tensile properties, creep rupture

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Key Words: Udimet 700, MERL 76, IN-100, RENE' 95, grain boundaries, notch properties, aging, embrittlement

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Wilhelm, H.
NTIS, N85-16191, Springfield, VA
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Key Words: Udimet 700, IN-100, RENE' 95, MERL 76, weld and post weld, tensile properties, fatigue

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Pratt and Whitney Aircraft Group, East Hartford, CT
Quarterly Technical Progress Report Number Twenty Four, Dec 81-Feb.82
Contract No : NAS 3-20072
44 pp., 1982 (AD-D124 466)
Key Words: MERL 76, Hastelloy X, Incoloy 901, AMS 5616, AMS 4928, MA956, JT-9D, JT-8D, turbine components, coatings, erosion, fatigue

12. **Hot Isostatically Pressed Manufacture of High Strength MERL 76 Disk and Seal Shapes**
Eng, R. D., Evans, D. J.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Final Report
Rept No : NASA-CR-165549, 138 pp., 1982 (AD-D125 120)
Key Words: MERL 76, Waspaloy, turbine components, tensile properties, creep, fatigue, notch sensitivity

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Evans, D. J.
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Rept No : NASA-CR-165550, 11 pp., 1982 (AD-D126 061)
Key Words: IN-100, MERL 76, JT-9D, turbine components, fatigue, net shape forming, nondestructive testing

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Thompson, E. R.
Annual Reviews Inc., Palo Alto, CA
Annual Review of Materials Science (book) 12, 213-42, 1982 (AD-D126 273)
Key Words: IN-100, Udimet 700, RENE' 95, MERL 76, Ti-6Al-4V, creep rupture, fatigue, fracture toughness

15. **Recent Developments in Powder Metallurgy of Superalloys**
Gessinger, G. H.
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Key Words: MERL 76, Udimet 700, RENE' 95, IN-738, MA6000E, MAR-M200, mechanical properties, corrosion, superplastic forming, thermomechanical treatment

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Quarterly Technical Progress Report Number Twenty Two, Jun.-Aug. 1981
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36 pp., 1981 (AD-D122 325)
Key Words: Hastelloy X, MA956, Udimet 700, MERL 76, turbine components, combustor liners, airfoils, coatings, fatigue, erosion resistance

17. **Microstructural Behavior of Interfaces in Hot Isostatically Pressed Dual Alloy Combinations**
Harf, F. H.
National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Technical Memorandum
Rept No : NASA-TM-82698, 10 pp., 1981 (AD-D122 440)
Key Words: MERL 76, Udimet 700, RENE' 95, turbine components, microstructure, phase studies, prealloying, interface

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Moll, J. H.
Mech Eng 103 (11), 56-61, 1981 (AD-D122 795)
Key Words: RENE' 95, titanium alloys, tool steel, Udimet 700, IN-100, MERL 76, Waspaloy, turbine components, microstructure, tensile properties, stress intensity

19. **Plastic Flow and Fracture Processes in Powder Metallurgical Nickel- Base Superalloys**
Law, C. C., Blackburn, M. J.
Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
Final Report
Rept No : PWA-FR-13317, 134 pp., 1980 (AD-A086 697)
Key Words: AF-115, MERL 76, MAR-M432, microstructure, tensile properties, notch properties, fatigue, creep, plastic deformation

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Key Words: MERL 76, turbine components, creep properties, modelling

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Law, C. C., Blackburn, M. J.
Metall Trans 11A (3), 495-507, 1980 (AD-D117 895)
Key Words: AF-115, MAR-M432, IN-100, MERL 76, creep properties, tensile properties, lattice parameters, grain boundaries, heat treatment

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Evans, D. J., Henricks, R. J., Friedrich, L. A., Blecherman, S. S.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Technical Progress Report Number Sixteen, Dec 79-Feb-80
Contract No : NAS3-20072
44 pp., 1980 (AD-D118 687)
Key Words: MERL 76, Haynes 8077, MA956, turbine components, combustor liners, tensile properties, creep rupture, coatings, plasma deposition, dispersion hardening

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Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Technical Progress Report Number Seventeen, 1 Mar-31 May 1980
Contract No : NAS 3-20072
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Key Words: MERL 76, Haynes 8077, MA956, turbine components, combustor liners, compressor components, airfoils, fatigue, creep properties, coatings, mechanical properties

25. **Evaluation of the Cyclic Behavior of Aircraft Turbine Disk Alloys, Part 2**
Cowles, B. A., Warren, J. R., Haake, F. K.
Pratt and Whitney Aircraft Group, West Palm Beach, FL
Final Report
Rept No : PWA-FR-13153, 191 pp., 1980 (AD-D119 421)
Key Words: MERL 76, RENE' 95, IN-100, Waspaloy, Udimet 700, NASA IIB-7 fatigue crack growth, creep-fatigue, tensile properties, microstructure

26. **Application of Superalloy Powder Metallurgy for Aircraft Engines**
Dreshfield, R. L., Miner, R. V., Jr.
National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Technical Memorandum
Rept No : NASA-TM-81466, 21 pp., 1980 (AD-D119 422)
Key Words: RENE' 95, Udimet 700, MERL 76, turbine components, tensile properties, creep properties, fatigue

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Quarterly Technical Progress Report Number Eighteen, 1 Jun-31 Aug 1980
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Key Words: MERL 76, MA956, Hastelloy X, turbine components, tensile properties, fatigue, coatings

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Key Words: MERL 76, Haynes 8077, MA956, aircraft engines, turbine components, combustor liners, compressor components, airfoils, fatigue, net shape forming, coatings

29. **High Strength HIP Consolidated MERL 76 Disks**
Eng, R. D., Evans, D. J.
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Proc 4th Int Symp Superalloys, Superalloys 1980, 491-500, 1980 (AD-D120 678)
Key Words: MERL 76, turbine components, tensile properties, creep rupture, fatigue, notch rupture strength

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Dulis, E. J., Moll, J. H., Chandhok, V. K., Hebeisen, J. C.
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Key Words: Ti-6Al-4V, MERL 76, RENE' 95, aircraft structures, tensile properties, creep rupture

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Law, C. C., Blackburn, M. J.
Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
Annual Report Number Two
Rept No : PWA-FR-11749, 54 pp., 1979 (AD-A068 909)
Key Words: MERL 76, microstructure, creep rupture, shot peening

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Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Report Number Twelve
Rept No : PWA-5574-49, 52 pp., 1979 (AD-D115 609)
Key Words: MERL 76, turbine components, grain size, tensile properties, creep properties, fatigue, welding

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Evans, D. J., Gell, M.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Progress Report Number Thirteen
Contract No : NAS3-20072
47 pp., 1979 (AD-D116 198)
Key Words: Haynes 8077, MA956, MERL 76, turbine components, combustor liners, tensile properties, creep properties, dispersion hardening

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Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Report Number Fourteen, 1 Jun-31 Aug 1979
Contract No : NAS3-20072
49 pp., 1979 (AD-D116 889)
Key Words: MERL 76, turbine components, tensile properties, creep properties, fatigue

35. **Materials for Advanced Turbine Engine-MATE**
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Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Contract No : NAS3-20072, 45 pp., 1979 (AD-D117 734)
Key Words: MERL 76, Waspaloy, turbine components, compressor components, creep properties, tensile properties, erosion resistance, coatings

36. **MATE-Materials for Advanced Turbine Engines**
Evans, D. J.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Contract No : NAS3-20072, 18 pp., 1978 (AD-D112 397)
Key Words: MERL 76, turbine components, porosity, microstructure

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Technical Progress Narrative Report One, Mar.-May 1978
Rept No : PWA-5574-21, 23 pp., 1978 (AD-D113 125)
Key Words: MERL 76, Udimet 700, turbine components, JT10D, tensile properties, creep rupture, microstructure, dimensional stability

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Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
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Key Words: MERL 76, turbine components, porosity, tensile properties, thermal exposure, SEM

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Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
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Key Words: MERL 76, turbine components, tensile properties, creep rupture, net shape forming

NASA IIB-11

1. **Effects of C and Hf Concentration on Phase Relations and Microstructure of a Wrought Powder-Metallurgy Superalloy**
Miner, R. V., Jr.
Metall Trans 8A (2), 259-63, 1977 (AD-D108 755)
Key Words: NASA IIB-11, carbon addition, hafnium addition, turbine components, microstructure, phase studies, gamma prime, carbide precipitation

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Kent, W. B.
Cyclops Corp., Universal Cyclops Specialty Steel Division, Pittsburgh, PA
Rept No : N76-20208, 110 pp., 1977 (AD-D109 486)
Key Words: NASA IIB-11, turbine components, thermal stability, microstructure, creep rupture, tensile properties, grain size, heat treatment

3. **An Experimental P/M Wrought Superalloy for Advanced Temperature Service**
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Key Words: NASA IIB-11, turbine components, tensile properties, grain growth, Larsen-Miller curves, creep rupture, long term tests, gamma prime

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Miner, R. V., Jr., NASA, Lewis Research Center, Cleveland, OH
Technical Note, Rept No : E-8468, 35 pp., 1976 ,(AD-D102 508)
Key Words: NASA IIB-11, AF 2-1DA, AF-115, turbine components, microstructure, grain size, gamma prime, creep rupture, tensile properties, Larsen-Miller curves

Nimonic 80

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Kramer, K-H., Powder Metall Int., 9 (3), 105-12, 1977 ,(AD-D110 805).
Key Words: IN-738, Udimet 700, Nimonic 80A, dispersion hardening yttrium addition, mechanical alloying, grain size, grain structure, creep rupture, recrystallization

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Wallis, P. B.,Powder Metall Int 8 (4), 167-9, 1976 ,(AD-D108 681)
Key Words: Nimonic 75, Nimonic 80A, Nimonic 81, Nimonic 90, Nimonic 105, Nimonic 115, Incoloy 901, Nimonic PE11, Nimonic PE16, Nimonic 263, Inconel 718, Inconel X-750, Nimocast 80, Nimocast 242, Nimocast 263, Alloy 713C, Alloy 713LC, Nimocast PD21, Nimocast PE10, Nimocast PK24, IN-738, turbine components

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Thompson, F. A., Williams, D. L.
AGARD Structures and Materials Panel 15 pp., 1974 (AD-D102 696)
Key Words: IN-100, Nimonic 105, Nimonic 90, Nimonic 80A, TD-nickel, turbine components, creep rupture, dispersion hardening, cost

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Gessinger,G.H., Bomford,M.J., Brown, Boveri & Co. Ltd., Baden, Switzerland
Proc Symp High Temp Materials in Gas Turbines 35 pp., 1973,(AD-D102 997)
Key Words: Udimet 500, Hastelloy X, X-45, Udimet 710, IN-100, IN-853 Udimet 700, RENE' 95, Inconel 718, D-979, Nimonic 80A, TD-nickel, turbine components, creep rupture, tensile properties, fatigue, atomization, REP, thermomechanical treatment

Rene' 80

1. **Hot Isostatic Press**
Author Anon ,Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985
(AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

2. **Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
General Electric Co., Gas Turbine Division, Schenectady, NY
Technical Paper
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

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Hanes, H. D., Seifert, D. A., Watts, C. R.
Metals Information Analysis Center, West Lafayette, IN
Rept No : MCIC-77-34, 101 pp., 1977 (AD-A049 227)
Key Words: T-111, Ti-6Al-4V, AA A356-T61, IN-738, RENE' 80, Udimet 700, IN-792, welding, tensile properties, pressure bonding

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5. **Process for High-Integrity Casting**
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General Electric Co., Aircraft Engine Group, Evendale, OH
Interim Engineering Report Aug-Oct 72
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Key Words: RENE' 80, Ti-6Al-4V, densification

Rene' 95

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Rept No : R78AEG265, 111 pp., 1978 (AD-D112 563)
Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, creep properties, crack growth, notch sensitivity, tensile properties, thermal properties, oxidation, corrosion, fatigue

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Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, coatings, microstructure, net shape forming

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General Electric Co., Aircraft Engine Group, Evendale, OH
Quarterly Engineering Report Number Ten, Jun-Aug 78
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Key Words: RENE' 95, RENE' 150, turbine components, compressor components, unidirectional solidification, tensile properties, fatigue, creep rupture, coatings

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Dept of Metallurgy and Materials Engineering, Lehigh Univ. Bethlehem, PA
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Key Words: Udimet 700, cobalt addition, chromium addition, molybdenum addition, aluminum addition, heat treatment, creep rupture, tensile properties

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Key Words: APK-1, Udimet 700, microstructure, tensile properties, fracture mechanics, creep rupture, fracture surface, cracking, aging

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50. **European Concerted Action COST 50: Materials for Gas Turbines CCR2: The Effect of Time-Dependent Processes on the LCF Life of Gas Turbine Disc Alloys**
Bressers, J., Roth, M., Tambuyser, P., Fenske, E.
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Key Words: MERL 76, Waspaloy, turbine components, tensile properties, creep, fatigue, notch sensitivity

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Bressers, J., Roth, M., Tambuyser, P., Fenske, E.
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Key Words: Waspaloy, Udimet 700, turbine components, microstructure, fractography, oxidation, crack growth, fatigue, tensile properties,

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Cowles, B. A., Warren, J. R., Haake, F. K.
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Key Words: MERL 76, RENE' 95, IN-100, Waspaloy, Udimet 700, NASA IIB-7 fatigue crack growth, creep-fatigue, tensile properties, microstructure

12. **Manufacture of Low Carbon Astroloy Turbine Disk Shapes by Hot Isostatic Pressing-Volume 2**
Eng, R. D., Evans, D. J.
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Key Words: Udimet 700, Waspaloy, turbine components, tensile properties, net shape forming, nondestructive testing

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Key Words: A-286, Incoloy 901, Inconel 718, Waspaloy, RENE' 95, Pyromet CTX-1, Pyromet 31, tensile properties, creep rupture, microstructure

15. **Manufacture of Low Carbon Astrology Turbine Disk Shapes by Hot Isostatic Pressing**
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Key Words: Waspaloy, Nimonic 901, Inconel 718, turbine components, tensile properties, creep rupture, fatigue, notch properties, fabrication

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Key Words: AF 2-1DA, MAR-M432, TRW NASA VI A, Udimet 700, turbine components, particle size, density, fatigue, crack growth, creep rupture, tensile properties, thermomechanical treatment

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TITANIUM AND TITANIUM ALLOYS

Titanium

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   Key Words: titanium, hardness, cost

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   Department of Materials Science and Engineering, Pennsylvania State University, University Park, PA
   Technical Report Number Four
   Contract No : N00014-084-K-0381, 25 pp., 1987 (AD-A176 617)
   Key Words: titanium, plasma deposition, REP, porosity, density, microstructure

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   Department of Materials Science and Engineering, Pennsylvania State University, University Park, PA
   Technical Report Number Six
   Contract No : N00014-86-K-0381
   41 pp., 1987 (AD-A183 566)
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   Key Words: Ti-6Al-4V, titanium, mechanical properties

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   Key Words: titanium, Corona-5, F-14 aircraft, F-18 aircraft, crack propagation, near net shape, fatigue

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Key Words: IMI 829, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-4V, Corona-5 Ti-5Al-2Cr-1Fe, Ti-5Al-2.5Fe, microstructure, fatigue life crack initiation, tensile properties

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Key Words: Ti-6Al-4V, Corona-5, aircraft structures, F-14 aircraft, fatigue, crack growth, tensile properties, superplastic forming, cost

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Key Words: Corona-5, microstructure, electron beam welding, welds, fracture toughness, fatigue, fractography, tensile properties, intergranular fracture

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Deel, Omar
Battelle Memorial Institute, Columbus, OH
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Key Words: AA 7010-T73651, Corona-5, AA A357-T6, IN-792, fatigue, bearing strength, tensile properties, thermal expansion

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Materials 1980 : Proc 12th Natl SAMPE Tech Conf 12, 538-53, 1980 (AD-D312 945)
Key Words: titanium, Corona-5, F-14 aircraft, F-18 aircraft, crack propagation, near net shape, fatigue

Ti-5Al-2.5Sn

1. **On the Effects of NaCl on Porosity in Elemental-Blend Powder-Metallurgy Ti-5Al-2.5Sn**
Jackson, A. G., Moteff, J., Froes, F. H.
Metall Trans 15A (1), 248-9, 1984 (AD-D129 167)
Key Words: Ti-5Al-2.5Sn, porosity, microstructure

2. **Transient Liquid Phase Sintering of P/M Titanium**
Patterson, B. R., Bates, C. E.
Southern Research Institute, Birmingham, AL
Rept No : SORI-EAS-82-C-5021, 74 pp., 1983 (AD-D124 462)
Key Words: Ti-5Al-2.5Sn, Ti-6Al-6V-2Sn, density, sintering, net shape forming.

3. **Dispersion Hardening of the Ti-5Al-2.5Sn Alloy Using a Powder Metallurgy Approach**
Jackson, A. G., Moteff, J., Froes, F. H.
The Metallurgical Society of AIME, Warrendale, PA
Proc 4th Int Conf Titanium, Titanium'80-Science and Technology 4, 2461-70, 1980 (AD-D121 369)
Key Words: Ti-5Al-2.5Sn, microstructure, porosity, dispersion hardening, aging

4. **Advanced Titanium Alloy Development Via Powder Metallurgy**
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Proc Symp Powder Metallurgy of Titanium Alloys, 229-41, 1980 (AD-D127 439)
Key Words: Ti-6Al-4V, Ti-5Al-2.5Sn, silicon and germanium, porosity,dispersions

Ti-6Al-2Sn-4Zr-2Mo

1. **Fatigue property Enhancement of Alpha-Beta Titanium Alloys by Blended Elemental P/M Approach**
Hagiwara, M., Kaieda, Y., Kawabe, Y., Miura, S.
Iron Steel Inst Jpn Inter 31 (8), 922-30, 1991
Key Words: IMI 829, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-4V, Corona-5 Ti-5Al-2Cr-1Fe, Ti-5Al-2.5Fe, microstructure, fatigue life crack initiation, tensile properties

2. **P/M Processing of Titanium Aluminides**
Moll, John H., Yolton, C. F., McTiernan, B. J.
Int J Powder Metall 26 (2), 149-55, 1990
Key Words: Ti(3)Al, Ti-25Al-10Nb-3V-1Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-48 at pct Al-1 at pct V, microstructure, particle size, tensile properties, stress rupture, plasma spraying

3. **P/M Titanium Technology for High Performance Uses**
Moll, J. H., Yolton, C. F., Chandhok, V. K.
Ind Heat 55 (5), 24-30, 1988 (AD-D138 992)
Key Words: Ti-6Al-4V, Ti-6Al-2Sn-4Zr-2Mo, near net forming, REP, atomization, tensile properties, creep rupture

4. **High Temperature Rapidly Solidified Titanium Alloy Evaluation**
Anderson, R. E.
Pratt and Whitney, Engineering Div, West Palm Beach, FL
Interim Technical Report Feb Apr 87
Rept No . P&W/ED/FR-19120-7, 19 pp., 1987 (AD-D138 557L)
Key Words: Ti-6Al-2Sn-4Zr-6Mo, Ti-8Al-1Mo-1V, Ti-6Al-2Sn-4Zr-2Mo, microscopy, porosity, tensile properties

5. **Consolidation of Prealloyed Ti-6Al-2Sn-4Zr-2Mo Spherical Powders**
Birla, N. C., Krishnaswamy, W.
Powder Metall 24 (4), 203-9, 1981 (AD-D122 929)
Key Words: Ti-6Al-2Sn-4Zr-2Mo, microstructure, tensile properties, consolidation, explosive compaction

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Roberson, J. A., Adair, A. M., Lipsitt, H. A.
Aerospace Research Labs, Wright-Patterson AFB, OH
Rept No : ARL-75-0135, 6 pp., 1975 (AD-A014 241)
Key Words: Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-6V-2Sn, microstructure, hot working

Ti-6Al-2Sn-4Zr-6Mo

1. **Fabrication and Evaluation of Production-Size Quantities of Rapidly Solidified Ti-6Al-2Sn-4Zr-6Mo-.75Er**
Martin, R. L., Tarnacki, G.
TMS, Warrendale, PA
Proc Symp Light-Weight Alloys Aerosp Appl TMS Annu Meet Feb-Mar 1989 123-37, 1989
Key Words: *Ti-6Al-2Sn-4Zr-6Mo, erbium addition, turbine components,* airframes, rapid solidification, gas atomization, production, extrusion, forging, tensile properties, fracture toughness, creep

2. **High Temperature Rapidly Solidified Titanium Alloy Evaluation**
Anderson, R. E., Martin, R. L.
Pratt and Whitney, Engineering Div, West Palm Beach, FL
Rept No : P&W/ED/FR-19120-9, 19 pp., 1987 (AD-D138 336L)
Key Words: Ti-6Al-2Sn-4Zr-6Mo, microstructure, alloy development, machining, forging, rapid solidification

3. **High Temperature Rapidly Solidified Titanium Alloy Evaluation**
Anderson, R. E.
Pratt and Whitney, Engineering Div, West Palm Beach, FL
Interim Technical Report Feb-Apr 87
Rept No : P&W/ED/FR-19120-7, 19 pp., 1987 (AD-D138 557L)
Key Words: Ti-6Al-2Sn-4Zr-6Mo, Ti-8Al-1Mo-1V, Ti-6Al-2Sn-4Zr-2Mo, microscopy, porosity, tensile properties

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Irving, R. R.
Iron Age 223 (28), 41-5, 1980 (AD-D118 875)
Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

5. **On the Heat Treat Response of Ti-6Al-2Sn-4Zr-6Mo Powder Forgings**
Chen, C. C.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Powder Metallurgy of Titanium Alloys, 139-49, 1980 (AD-D127 433)
Key Words: Ti-6Al-2Sn-4Zr-6Mo, microstructure, tensile properties, fracture toughness

6. **Hot Isostatic Pressing of Large Titanium Shapes**
Petersen, V. C., Chandhok, V. K., Kelto, C. A.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Powder Metallurgy of Titanium Alloys, 243-54, 1980 (AD-D127 440)
Key Words: Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, aircraft structures, engine components, tensile properties, net shape forming

7. **Manufacturing Methods for Production of Titanium Alloy Compressor Disks from Powder Billet**
Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
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Key Words: Ti-6Al-2Sn-4Zr-6Mo, microstructure, tensile properties, fatigue, creep, gatorizing

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Pratt and Whitney Aircraft Group, West Palm Beach, FL
Interim Engineering Progress Report Number Seven, Jan 74-Mar 76
Rept No : AFML-IR-174-2(VII), 63 pp., 1976 (AD-D108 115L)
Key Words: Ti-6Al-2Sn-4Zr-6Mo, turbine components, microstructure, forging, fracture, gatorizing, tensile properties, creep rupture

Ti-6Al-4V

1. **Fatigue property Enhancement of Alpha-Beta Titanium Alloys by Blended Elemental P/M Approach**
Hagiwara, M., Kaieda, Y., Kawabe, Y., Miura, S.
Iron Steel Inst Jpn Inter 31 (8), 922-30, 1991
Key Words: IMI 829, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-4V, Corona-5 Ti-5Al-2Cr-1Fe, Ti-5Al-2.5Fe, microstructure, fatigue life crack initiation, tensile properties

2. **Powder Metallurgy of Titanium Alloys**
Froes, F. H., Eylon, D.
Int Mater Rev 35 (3), 162-82, 1990 (AD-D144 188)
Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, microstructure, crack growth, fatigue, fracture toughness, tensile properties, porosity, near net shape

3. **Effect of Degassing Treatment on Microstructure and Mechanical Properties of P/M Ti-6Al-4V**
Lee, Y.T., Schurmann, H., Grundhoff, K.J., Peters, M.
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Key Words: Ti-6Al-4V, microstructure, tensile properties, fatigue, fracture toughness

4. **Manufacture of a Novel Porous Material**
Kearns, M. W., Blenkinsop, P. A., Barber, A. C., Farthing, T. W.
Int J Powder Metall 24 (1), 59-64, 1988 (AD-D138 482)
Key Words: Ti-6Al-4V, consolidation, damping, hot working

5. **P/M Titanium Technology for High Performance Uses**
Moll, J. H., Yolton, C. F., Chandhok, V. K.
Ind Heat 55 (5), 24-30, 1988 (AD-D138 992)
Key Words: Ti-6Al-4V, Ti-6Al-2Sn-4Zr-2Mo, near net forming, REP, atomization, tensile properties, creep rupture

6. **Production of Powder Ti-Alloy Rings by Means of Compaction and Radial-Rolling**
Szczepanik, S., Kopp, R., Wiegels, H.
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Key Words: Ti-6Al-4V, microstructure, deformation, fracture surface, rolling, forging

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Locci, I. E., Welsch, G., Eylon, D., Froes, F. H.
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Key Words: Ti-6Al-4V, microstructure, fracture surface, REP, plastic deformation

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Roberts, P.R., Airey, J.J.
MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
Proc Int Conf PM Aerospace Materials-87, 17.1-17.15, 1988 (AD-D143 665)
Key Words: Ti-6Al-4V, ingot metallurgy, near net shape, REP, plasma deposition, fatigue stress

9. **Effect of Thermomechanical Treatment on the Fatigue Behavior of PM Ti-6Al-4V Containing Artificial Contaminants**
Wirth, G., Grundhoff, K.J., Eylon, D., Froes, F.H.
MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
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Key Words: Ti-6Al-4V, REP, fatigue stress, fracture,

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Lee, Y-T., Grundhoff, K. J., Wirth, G.
Z Metallk 78 (1), 49-57, 1987 (AD-D136 922)
Key Words: Ti-6Al-4V, microstructure, fatigue crack, PREP, aging, tensile properties

11. **Characteristic Properties of Hot Isostatically Pressed Ti-6Al-4V Alloys**
Majima, K., Hirata, T., Yamamoto, M., Shoji, K.
J Jpn Soc Powder Powder Metall 34 (5), 211-16, 1987 (AD-D137 819)
Key Words: Ti-6Al-4V, microstructure, fractography, REP, tensile properties

12. **Evaluation and Application of Prealloyed Titanium P/M Parts for Airframe Structures**
Sheinker, A. A., Chanani, G. R., Bohlen, J. W.
Int J Powder Metall 23 (3), 171-6, 1987 (AD-D140 441)
Key Words: Ti-6Al-4V, F-18A aircraft, corrosion, REP, tensile properties, shear, fracture toughness

13. **Advanced Processing and Properties of High-Performance Alloys**
Koss, D. A.
Department of Metallurgical Engineering, Michigan Tech University, Houghton
Technical Report Number Four
Contract No : N00014-85-K-0427
19 pp., 1986 (AD-A167 404)
Key Words: Ti-6Al-4V, AA 7075-T6, AA 1100, AISI 316, fabrication, rapid solidification

14. **Correlations Between Post-HIP Treatment, Resulting Microstructure, and Fatigue Behavior of Prealloyed Ti-6Al-4V Powder Compacts**
Wirth, G., Grundhoff, K. J., Smarsly, W.
SAMPE Qtrly 17 (2), 34-9, 1986 (AD-D134 466)
Key Words: Ti-6Al-4V, microstructure, TEM, tensile properties, fatigue stress

15. **Influence of Foreign Particles on Fatigue Behavior of Ti-6Al-4V Prealloyed Powder Compacts**
Schwenker, S. W., Eylon, D., Froes, F. H.
Metall Trans 17A (2), 271-80, 1986 (AD-D134 809)
Key Words: Ti-6Al-4V, alumina addition, silica addition, crack propagation, tensile properties, fatigue stress

16. **Improvement of Mechanical Properties of Blended Elemental Ti-6Al-4V Alloy Through Microstructural Modification**
Haziwara, M., Kaieda, Y., Kawabe, Y.
J Iron Steel Inst Japan 72 (6), 685-92, 1986 (AD-D135 327)
Key Words: Ti-6Al-4V, tensile properties, fracture toughness, fatigue stress

17. **Microstructure/Property Relationships in Prealloyed Ti-6Al-4V**
Friedman, G. I., Moxson, V. S.
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Key Words: Ti-6Al-4V, turbine components, microstructure, aging, beta processing, tensile properties, fatigue crack

18. **Superior Fatigue Properties for Blended Elemental P/M Ti-6Al-4V**
Abkowitz, S., Rowell, D.
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Key Words: Ti-6Al-4V, turbine components, microstructure, net shape forming, tensile properties, fatigue

19. **HIP Compaction of Titanium Alloy Powders at High Pressure and Low Temperature (HPLT)**
Eylon, D., Froes, F. H.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Titanium, Rapid Solidification Technology, 273-89, 1986 (AD-)
Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, rapid solidification, REP, tensile properties, fatigue

20. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
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Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

21. **Coatings and PM Research at CEN Grenoble**
Williams, B.
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Key Words: Ti-6Al-4V, TiN coatings, sputtering

22. **Thermally Induced Porosity in Ti-6Al-4V Prealloyed Powder Compacts**
Eylon, D., Schwenker, S. W., Froes, F. H.
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Key Words: Ti-6Al-4V, microstructure, REP, thermally induced porosity

23. **Microporosity in Hot Isostatically Pressed Ti6Al4V Powder Compacts**
Smarsly, W., Lee, Y. T., Welsch, G.
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Key Words: Ti-6Al-4V, microstructure, oxide addition

24. **Effect of Thermomechanical Treatments of Ti6Al4V PSV Powders on the Improvement of the Low Cycle Fatigue of Sintered Compacts**
Devillard, J.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
1, 287-94, 1985 (AD-D135 668)
Key Words: Ti-6Al-4V, microstructure, fracture surface, crack propagation, tensile properties, fatigue

25. **Low and High Cycle Fatigue Behavior of P/M Ti6Al4V with Respect to Microstructure Developed During Processing**
Wirth, G., Grundhoff, K. J.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
1, 347-54, 1985 (AD-D135 672)
Key Words: Ti-6Al-4V, microstructure, fracture, fatigue crack, tensile properties

26. **Combined Die Forging (CDF) of Prealloyed Ti6Al4V Powder**
Smarsly, W., Bunk, W., Kopp, R.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
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Key Words: Ti-6Al-4V, microstructure, near shape forming, forging

27. **Effect of Advanced Powder Production Processes on Powder Characteristics and Mechanical Properties of HIP Compacts of Prealloyed Ti6Al4V**
Grundhoff, K. J., Wirth, G.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
1, 405-10, 1985 (AD-D135 681)
Key Words: Ti-6Al-4V, crack propagation, tensile properties, fatigue

28. **Fatigue Failure Analysis of Ti6Al4V Powder Compacts Produced by Different Techniques**
Wirth, G., Grundhoff, K. J., Smarsly, W., Froes, F. H., Eylon, D.
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Proc 5th Int Conf Titanium, Titanium--Science and Technology
1, 427-34, 1985 (AD-D135 683)
Key Words: Ti-6Al-4V, fracture, tensile properties, fatigue, REP

29. **Introduction of Titanium Powder Metallurgy Components to Aircraft Series Production**
Keinath, W., Engels, J.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
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Key Words: Ti-6Al-4V, tensile properties, shot peening, heat treatment

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Buhl, H.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
4, 2549-55, 1985 (AD-D136 826)
Key Words: Ti-6Al-4V, fracture, stress, corrosion

31. **Fatigue Improvement of Prealloyed and Blended Elemental Titanium Powder Metallurgy Compacts by Microstructure Modifications**
Eylon, D., Vogt, R. G., Froes, F. H.
Metal Powder Industries Federation, Princeton, NJ
Proc Int Powder Metallurgy Con., Modern Developments in Powder Metallurgy
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Key Words: Ti-6Al-4V, grain refinement, tensile properties, fatigue, REP

32. **Application of Advanced Powder Process Technology to Titanium Aeroengine Components**
Broomfield, R. W., Turner, N. G., Leat, B. I.
Powder Metall 28 (1), 27-34, 1985 (AD-D140 920)
Key Words: Ti-6Al-4V, turbine components, microstructure, consolidation, tensile properties, fatigue, impact properties

33. **Powder Metallurgy of Light Metal Alloys for Demanding Applications**
Froes, F. H., Pickens, J. R.
Air Force Wright Aeronautical Labs, Wright-Patterson AFB, OH
Final Report
J Met Rept No : AFWAL-TR-84-4084, 36 (1), 18 pp., 1984 (AD-A142 066)
Key Words: AA 7090, AA 7091, Ti-6Al-4V, rapid solidification, mechanical attritioning, tensile properties

34. **Deformation and Fracture of P/M (Powder/Metallurgy) Titanium Alloys**
Koss, D. A.
Department of Metallurgical Engineering, Michigan Tech University, Houghton
Annual Technical Report Number Twenty Seven
Contract No : N00014-76-C-0037
26 pp., 1984 (AD-A148 672)
Key Words: Ti-6Al-4V, AA 7075-T6, porosity, hydrogen embrittlement, tensile properties, fracture

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Bourcier, R. J., Koss, D. A., Smelser, R. E., Richmond, O.
Department of Metallurgical Engineering, Michigan Tech University, Houghton
Technical Report Number Twenty Six
36 pp., 1984 (AD-A148 766)
Key Words: Ti-6Al-4V, microscopy, tensile properties, deformation

36. **Powder Metallurgy Gaining Trust of Aero Designers**
Wigotsky, V.
Aerospa Amer 22 (3), 90-4, 1984 (AD-D129 541)
Key Words: Ti-6Al-4V, RENE' 95, AA 7090, AA 7091, Al-8Fe, turbine components, shear properties, compressive properties, net shape forming

37. **Feasibility of Inclusion Detection and Characterization in Titanium Powder Compacts Using Ultrasonics**
Kwun, H., Singh, G. P., Fujisawa, K., Froes, F. H., Eylon, D.
NDT Int 17 (2), 73-9, 1984 (AD-D129 632)
Key Words: Ti-6Al-4V, inclusions, nondestructive testing

38. **Powder Metallurgy in the Federal Republic of Germany**
Thummler, F., Oberacker, R.
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Key Words: Ti-6Al-4V, net shape forming

39. **Metallography of Hot Isostatically Pressed Materials (Part 2)**
Piske, D., Wittner, I.
Pract Metall 21 (3), 107-17, 1984 (AD-D130 404)
Key Words: Ti-6Al-4V, Stellite 6, WC coating, diffusion welding and bonding

40. **Microstructures and Tensile Properties of Hot Isostatically Pressed Rotating Electrode Process Ti-6Al-4V Alloy Powders**
Hagiwara, M., Kaieda, Y., Kawabe, Y.
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Key Words: Ti-6Al-4V, microstructure, REP, aging, tensile properties

41. **Mechanical Properties of Advanced Titanium Powder Metallurgy Compacts**
Herteman, J. P., Eylon, D., Froes, F. H.
Powder Metall Int 17 (3), 116-8, 1984 (AD-D132 989)
Key Words: Ti-6Al-4V, turbine components, fracture toughness, fatigue, plasma arc melting

42. **Titanium Powder Metallurgy--A Review**
Froes, F. H., Eylon, D.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Titanium--Net Shape Technologies, 1-20, 1984 (AD-D134 588)
Key Words: Ti-6Al-4V, rare earth addition, microstructure, grain size, bending, tensile properties, fatigue stress

43. **Study of Production Methods of Aerospace Quality Titanium Alloy Powder**
Peebles, R. E., Parsons, L. D.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Titanium--Net Shape Technologies, 21-8, 1984 (AD-D134 589)
Key Words: Ti-6Al-4V, microstructure, fracture toughness, tensile properties, fatigue stress

44. **Modification of Titanium Powder Metallurgy Alloy Microstructures by Strain Energizing and Rapid Omni-Directional Compaction**
Mahajan, Y. R., Eylon, D., Kelto, C. A., Egerer, T., Froes, F. H.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Titanium--Net Shape Technologies, 38-51, 1984 (AD-D134 591)
Key Words: Ti-6Al-4V, microstructure, rapid solidification, tensile properties, fatigue stress

45. **Titanium Alloy Shapes from Elemental Blend Powder and Tensile and Fatigue Properties of Low Chloride Compositions**
Abkowitz, S., Kardys, G. J., Fujishiro, S., Froes, F. H., Eylon, D.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Titanium--Net Shape Technologies, 107-20, 1984 (AD-D134 596)
Key Words: Ti-6Al-4V, net shape forming, tensile properties, gas tungsten arc welding, fatigue stress

46. **Suiting Blended Elemental Powder Metallurgy Material/ Processing to Parts**
Friedman, G. I.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Titanium--Net Shape Technologies, 121-9, 1984 (AD-D134 597)
Key Words: Ti-6Al-4V, manufacturing, hydrostatic compaction

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Renpo, T., Tao, L., Changchun, L.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
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Key Words: Ti-6Al-4V, microstructure, fracture, tensile properties, impact toughness, fatigue stress

48. **Superplastic Forging of HIP'ed Ti-6Al-4V Alloy Preforms**
Nishino, Y., Kimura, T., Yamauchi, T., Oka, T.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
2, 673-80, 1984 (AD-D135 997)
Key Words: Ti-6Al-4V, microstructure, REP, flow stress, stress-strain

49. **Mechanical Property Microstructure Relationships in Alloys**
Eylon, D., Kim, Y. W.
Metcut Research Associates Inc., Materials Research Group, Wright-Patterson AFB, OH
Rept No : AFWAL-TR-83-4131, 54 pp., 1983 (AD-D139 731L)
Key Words: Ti-6Al-4V, AA 7091, IN9051, AA 7075, turbine components, tensile properties, fatigue, bending

50. **Deformation and Fracture of P/M Titanium Alloys**
Koss, D. A.
Department of Metallurgical Engineering, Michigan Tech University, Houghton
Annual Report Number Twenty Three
18 pp., 1983 (AD-A135 612)
Key Words: Ti-6Al-4V, porosity, ductile fracture, fracture strain

51. **Fatigue Properties of Hot Isostatically Pressed Ti-6Al-4V Powders**
Froes, F. H., Eylon, D., Wirth, G., Grundhoff, K. J., Smarsly, W.
Met Powder Rept 38 (1), 36-41, 1983 (AD-D126 646)
Key Words: Ti-6Al-4V, fatigue, crack growth, tensile properties

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Vaccari, J. A., Amer Mach 127 (5), 121-36, 1983 (AD-D127 193)
Key Words: AA 7090, AA 7091, IN9052, Ti-6Al-4V, Monel 400, Inconel 600, RENE 95, Cb291, Udimet 700, IN-100, AF-115, Inconel 625, net shape forming, injection molding, applications, forging

53. **Fatigue Crack Growth Rate of Ti-6Al-4V Prealloyed Powder Compacts**
Schwenker, S. W., Sommer, A. W., Eylon, D., Froes, F. H.
Metall Trans 14A (7), 1524-8, 1983 (AD-D127 927)
Key Words: Ti-6Al-4V, stress intensity factor, fracture surface, fatigue, crack growth

54. **Containerless HIPing of PM Parts: Technology Economics and Equipment Productivity**
Nyce, A. C.
Met Powder Rept 38 (7), 387-92, 1983 (AD-D128 150)
Key Words: AISI 4650, M-2, AISI 316L, Ti-6Al-4V, Monel 400, Stellite 6, Stellite 21, applications, cost, density, tensile properties

55. **Influence of Thermomechanical Processing on Low Cycle Fatigue of Prealloyed Ti-6Al-4V Powder Compacts**
Eylon, D., Froes, F. H., Heggie, D. G., Blenkinsop, P. A., Gardiner, R. W.
Metall Trans 14A (12), 2497-505, 1983 (AD-D128 792)
Key Words: Ti-6Al-4V, porosity, fatigue, microstructure, tensile properties, thermomechanical treatment

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Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, tensile properties, fatigue fracture toughness, density, cost

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Final Report, Apr 74-Apr 75
Contract No : N00019-74-C-0301
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Key Words: Ti-6Al-4V, IN-738, RENE' 77, IN-792, defects, diffusion bonding, elongation

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Rept No : USAAMRDL-TR-72-71, 86 pp., 1973 (AD-759 504)
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Rept No : Vol-1, 399-418, 1972 (AD-D105 328)
Key Words: Ti-6Al-4V, tungsten addition, oxygen addition, welding, porosity, tensile properties, thermal properties, microstructure, fracture toughness, crystal orientation, heat treatment, particle size

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Ti-6Al-6V-2Sn

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   Air Force Wright Aeronautical Labs, Wright-Patterson AFB, OH
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   Hagiwara, M., Kaieda, Y., Kawabe, Y.
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   The Metallurgical Society of AIME, Warrendale, PA
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   Key Words: Ti-6Al-6V-2Sn, fracture, crack growth, net shape forming, fatigue stress

5. **Process for Producing Parts with Deep Pocketed Precision Cavities Using P/M Shape Technology**
   Chandhok, V. K., Moll, J. H., Ulitchny, M. G.
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Key Words: Ti-6Al-6V-2Sn, aging, annealing, tensile properties, transus temperature

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Witt, R. H., Highberger, W. T.
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Ti-10V-2Fe-3Al

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Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, rapid solidification, REP, tensile properties, fatigue

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Chandler, H. E.
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Key Words: Ti-10V-2Fe-3Al, Ti-15V-3Cr-3Al-3Sn, steel, aircraft, net shape forming, manufacturing

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Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, Ti-6Al-6Zr-6Mo, Ti-6Al-6V-2Zr, tensile properties, microstructure, density

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Key Words: IMI 829, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-4V, Corona-5 Ti-5Al-2Cr-1Fe, Ti-5Al-2.5Fe, microstructure, fatigue life crack initiation, tensile properties

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Perrier, C., Naka, S., Kubin, L. P.
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Key Words: titanium alloys, yttrium addition, microstructure, grain boundaries, arc melting, rapid solidification, tensile properties, creep, aging

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Key Words: Ti-6Al-2Sn-4Zr-6Mo, Ti-8Al-1Mo-1V, Ti-6Al-2Sn-4Zr-2Mo, microscopy, porosity, tensile properties

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Department of Materials Science and Engineering, Pennsylvania State University, University Park, PA
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Key Words: titanium, Ti-10Al, AA 7075, AA 1100, erbium addition, porosity, voids, rapid solidification, fatigue, deformation, fracture mechanics

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Naka, S., Marty, M., Octor, H.
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Interim Technical Report Number Ten, Dec 85-Jan 86
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Key Words: titanium alloys, crack propagation, fracture, weldability, toughness, machinability

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Koss, D. A.
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Key Words: IMI 685, microstructure, crack propagation, tensile properties, fatigue

12. **Emerging Trends in Aerospace Materials and Processes**
Chandler, H. E.
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Key Words: Ti-10V-2Fe-3Al, Ti-15V-3Cr-3Al-3Sn, steel, aircraft, net shape forming, manufacturing

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Author Anon
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Rept No : FTD-ID(RS)T-0412-82, 335 pp., 1982 (AD-B070 680L)
Key Words: aluminum alloys, titanium alloys, mechanical properties, fatigue, cracking

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Jones, Dana J., Ford, S. C.
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Rept No : AFWAL-TR-82-4136, 168 pp., 1982 (AD-A122 963)
Key Words: Ti-6Al-4V, 10V2Fe3Al-Ti alloy, CT-91-TTE69 aluminum alloy, AF-1410 steel, extrusion, fracture toughness, creep rupture, stress corrosion, fatigue crack, tensile properties, compressive properties, thermal expansion, bearing strength

16. **Advanced Manufacturing Methods for High Quality, Low Cost Titanium Powder Production**
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Interim Engineering Progress Report Number Six , Dec 80-Sep 81
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Key Words: Ti-6Al-4V, Ti-5Al-2Sn-2Zr-4Cr-4Mo, REP, tensile properties, fracture toughness

17. **New Titanium Alloys for Blended Elemental Powder Processing**
Smugeresky, J. E., Dawson, D. B.
Powder Technol 30 (1), 87-94, 1981 (AD-D122 315)
Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, Ti-6Al-6Zr-6Mo, Ti-6Al-6V-2Zr, tensile properties, microstructure, density

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Moll, J. H.
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Key Words: RENE' 95, titanium alloys, tool steel, Udimet 700, IN-100, MERL 76, Waspaloy, turbine components, microstructure, tensile properties, stress intensity

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Peebles, R. E., Kelto, C. A.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Powder Metallurgy of Titanium Alloys, 47-58, 1980 (AD-D127 425)
Key Words: Ti-6Al-4V, Ti-17, microstructure, tensile properties, fatigue,

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Paez, C.
Grumman Aerospace Corp., Bethpage, NY
Third Quarterly Program Report Apr-Jul 78
Contract No : F33615-77-C-3109
61 pp., 1978 (AD-D113 509L)
Key Words: Ti-6Al-4V, Ti-15V-3Cr-3Al-3Sn, diffusion welding, superplastic forming, lap shear strength

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Interim Engineering Report, May-Nov 78
Rept No : AFML-IR-189-7T(4), 59 pp., 1978 (AD-D114 365L)
Key Words: Ti-6Al-4V, Ti-5Al-2Sn-2Zr-4Cr-4Mo, isothermal process, forging, hydriding

22. **Consolidation of Titanium Powder to Near Net Shapes**
Schwertz, J. H., Chandhok, V. K., Peterson, V. C., Thompson, V. R.
Colt Industries Inc., Crucible Materials Research Center, Pittsburgh, PA
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Rept No : AFML-TR-78-41, 333 pp., 1978 (AD-A078 039)
Key Words: Ti-6Al-4V, Ti-17, microstructure, fatigue, fracture, stress, Charpy impact, tensile properties, near net shape

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Third Technical Bulletin, Mar.-May 1978
Contract No : F33615-77-C-3109
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Key Words: Ti-6Al-4V, Ti-6Al-2Zn-2Sn-2Mo-2Cr

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Key Words: Ti-6Al-4V, Ti-6Al-2Zn-2Sn-2Mo-2Cr, welding, superplastic forming

25. **Powder Forging**
Huppmann, W. J., Hirschvogel, M.
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Key Words: titanium alloys, aluminum alloys, nickel alloys, beryllium, porosity, plasticity, impact strength, tensile properties, fatigue, sintering, cost, preheating

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Marley, W. F., Jr.
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Key Words: Maraging 300, titanium alloys, shock loading, dispersion hardening, thermomechanical treatment

INTERMETALLIC COMPOUNDS

Ni(3)Al

1. **Powder Processing of Intermetallic Alloys and Intermetallic Matrix Composites**
   Stoloff, N. S., Alman, D. E.
   Mater Sci Eng A A144, 51-62, 1991
   Key Words: Al(3)Ta, NiAl, Ni(3)Al, NbAl(3), TiAl, phase diagram, reactive sintering, densification, injection molding, reaction milling, mechanical alloying, Charpy impact, tensile properties

2. **High Temperature Deformation Behavior of the Ni(3)Al Compacts Produced by Hot Pressing of Mechanically Alloyed Powder**
   Esaki, H., Tokizane, M.
   Nippon Kinzoku Gakkaishi (J. Jpn. Inst. Met.) 55 (4), 452-8, 1991
   Key Words: Ni(3)Al, mechanical alloying, ball milling, compressive properties, strain rate sensitivity, dynamic recrystallization

3. **Modelling of Hipping Consolidation Applied to Ni(3)Al Powders**
   Wright, R. N., Williamson, R. L., Knibloe, J. R.
   Powder Metall 33 (3), 253-9, 1990
   Key Words: Ni(3)Al, Ni-19 at pct Al-8.5 at pct Cr, grain boundary diffusion, creep, tensile properties, atomization

4. **Intermetallic Compounds and Their Powder Metallurgy Materials**
   Ni, R., Sun, Yuan
   Foreign Technology Division, Wright-Patterson AFB, OH
   P/M Technology (Fenmo Yejin Jishu)
   Rept No : FTD-ID(RS)T-1058-90, 7 (4), 253-61, 1989 (AD-A237 176)
   Key Words: Ni(3)Al, turbine components, corrosion resistance, tensile properties, rapid solidification, grain growth, coatings

5. **Ni(3)Al-Base Alloys Processed by Rapid Solidification**
   Huang, S. C., Chang, K. M., Taub, A. I.
   Met Powder Rept 43 (2), 92-5, 1988 (AD-D138 292)
   Key Words: Ni(3)Al, boron addition, atomization, tensile properties

6. **Hot Isostatic Pressing of Nickel Aluminide Powders**
   Wright, R. N., Flinn, J. E.
   EG & G Idaho Inc., Idaho Falls, ID
   Technical Report
   Rept No : EGG-MG-7986, DE88 009677, 31 pp., 1988 (AD-D141 721)
   Key Words: Ni(3)Al, microscopy, grain size, densification, flow stress, tensile properties

7. **High-Temperature Fatigue Crack Propagation in P/M Ni3Al-B Alloys**
   Chang, K. M., Huang, S. C., Taub, A. I.
   Materials Research Society, Pittsburgh, PA
   Proc Symp Mater Res Soc 81, 303-8, 1987 ((AD-D145 078))
   Key Words: Ni(3)Al, Ni-12Al-12Co, T144, grain size, fatigue, crack growth, oxidation, tensile properties, fracture surface

8. **High Cycle Fatigue in Polycrystalline Ni(3)Al+B**
Fuchs, G. E., Stoloff, N. S.
Scr Metall 21 (6), 863-8, 1987 (AD-D137 117)
Key Words: Ni(3)Al, fracture, crack propagation, fatigue, tensile properties

9. **Effects of Processing and Impurities on the Elevated Temperature Ductility Loss in Rapidly Solidified Ni (3)Al-B**
Taub, A. I., Chang, K. W., Huang, S. C.
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Proc Conf Rapidly Solidified Mater, 297-302, 1986 (AD-D139 047)
Key Words: Ni(3)Al, plasma deposition, melt spinning, tensile properties

NiAl

1. **HIP and Sinter-HIP of Ternary Nickel Aluminide (NiAl)-X alloys**
Kaysser, W. A., Laag, R., Murray, J. C., Petzow, G.
Elsevier, London, UK
Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl, 215-22, 1992
Key Words: NiAl, gas atomization, sintering, microstructure, density, grain size, tensile properties, fracture path, fracture toughness, hardness, titanium additions niobium additions

2. **Consolidation of Nickel Aluminide Powders Using Hot Isostatic Pressing**
Wright, R. N., Knibloe, J. R., Noebe, R. D.
Mater Sci Eng A A141 (1), 79-83, 1991
Key Words: NiAl, density, HIP maps, diffusion

3. **Fabrication of Dense Nickel Aluminide Monolithic and Composite Bodies by Combined Self Propagating High Temperature Synthesis and In Situ Containerless Hot Isostatic Pressing**
Concannon, M., Hodge, E. S., Nyce, A. C., Turmel, C. P.
Materials Research Society, Pittsburgh, PA
Proc Symp Mater Res Soc, 913-8, 1991 (AD-D145 367)
Key Words: NiAl, boron addition, density, tensile properties, hardness

4. **A Comparative Study on the Influence of Nb and Ti Additions to Different Processed Atomized NiAl Powders**
Laag, R., Kaysser, W. A., Petzow, G.
Materials Research Society, Pittsburgh, PA
Proc Symp Mater Res Soc 213, 821-6, 1991 (AD-D145 357)
Key Words: NiAl, niobium addition, titanium addition, microstructure, grain size, impurities, fracture surface, intergranular fracture, transgranular fracture, fracture toughness, creep, hardness, elastic modulus, tensile properties, melting point, Poisson's ratio

5. **Powder Processing of Intermetallic Alloys and Intermetallic Matrix Composites**
Stoloff, N. S., Alman, D. E.
Mater Sci Eng A A144, 51-62, 1991
Key Words: Al(3)Ta, NiAl, Ni(3)Al, NbAl(3), TiAl, phase diagram, reactive sintering, densification, injection molding, reaction milling, mechanical alloying, Charpy impact, tensile properties

6. **Powder Processing of High Temperature Aluminides**
German, R.M., Bose, A., Stoloff, N.S.
Materials Research Society, Pittsburgh, PA
Proc Symp High-Temperature Ordered Intermetallic Alloys III
133, 403-14, 1989 (AD-D143 438)
Key Words: NiAl, TiAl, NbAl(3), Ta(2)Al(4),TaAl(3), microstructure, tensile properties

7. **Microstructures and Mechanical Behavior of Mechanically Alloyed Nickel Aluminide**
Wang, J. S. C., Donnelly, S. G., Godavarti, P., Koch, C C.
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Key Words: NiAl, microstructure, grain refinement, consolidation, mechanical alloying, tensile properties, fracture, creep

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Bose, A., Moore, B., Stoloff, N.S., German, R.M.
MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
Proc Int Conf PM Aerospace Materials-87, 4.1-4.13, 1988 (AD-D143 658)
Key Words: NiAl, Nb(3)Al, phase diagram, elongation, tensile properties

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Lawley, A., J Met 38 (8), 15-25, 1986 (AD-D136 435)
Key Words: NiAl, IN-100, MAR-M509, RENE' 95, AA 2024-T6, consolidation, REP, tensile properties, impact toughness

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Vedula, K., Anderson, G., Pathare, V., Aslandis, I.
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Proc Int Powder Metallurgy Conf, Modern Developments in Powder Metallurgy
16, 717-44, 1985 (AD-D138 357)
Key Words: FeAl, NiAl, hot extrusion, creep, compressive properties

Ti(3)Al

1. **Microstructure and Mechanical Properties of HIPed compacts of Mechanically Alloyed Titanium-Aluminum Powder**
Park, Y. H., Hashimoto, H., Watanabe, R., Ahn, J. H., Chung, H. S.
Mater Sci Forum, 88-90, 155-62, 1992
Key Words: TiAl, Ti(3)Al, Al(3)Ti, mechanical alloying, ball milling, microstructure, mechanical properties, microhardness

2. **Synthesis of Titanium Aluminide (TiAl) Intermetallic Compounds by HIP-Reaction Sintering**
Kakitsuji, A., Miyamoto, H., Elsevier, London, UK
Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl., 295-300, 1992
Key Words: TiAl, Ti(3)Al, reaction sintering, microstructure, grain size

3. **P/M Processing of Titanium Aluminides**
Moll, J. H. et al., Int J Powder Metall 26 (2), 149-55, 1990
Key Words: Ti(3)Al, Ti-25Al-10Nb-3V-1Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-48 at pct Al-1 at pct V, microstructure, particle size, tensile properties, stress rupture, plasma spraying

4. **Influence of Metallurgical Methods on the Properties of Ti(3)Al**
Weik, T., Breme, J., Borello, A., Seilstorfer, H., Moritz, R., Buzzanca, G.
Franzoni, U., Di Gianfrancesco, A., Toussaint, J. C.
Titanium Development Association, Boulder, CO, ISBN 0-935297-14-6
Proc Int Conf Titanium 1990, Products and Applications,
1, 170-9, 1990 (AD-D144 273)
Key Words: Ti(3)Al, microstructure, porosity, corrosion, oxidation, grain growth, compressive properties, tensile properties, creep, elastic modulus

5. **Improved Toughness Alloys Based on Titanium Aluminides**
Blackburn, M. J., Smith, M. P.
Pratt and Whitney Aircraft Group, West Palm Beach, FL
Final Report
Rept No : PW-FR-20760, 222 pp., 1989 (AD-A218 149)
Key Words: Ti(3)Al, turbine components, niobium addition, molybdenum addition, lanthanum addition, erbium addition, cerium addition, rapid solidification, thermomechanical treatment, fracture toughness, impact strength, tensile properties, creep rupture, fatigue

TiAl

1. **Microstructure and Mechanical Properties of HIPed compacts of Mechanically Alloyed Titanium-Aluminum Powder**
Park, Y. H., Hashimoto, H., Watanabe, R., Ahn, J. H., Chung, H. S.
Mater Sci Forum, 88-90, 155-62, 1992
Key Words: TiAl, Ti(3)Al, Al(3)Ti, mechanical alloying, ball milling, microstructure, mechanical properties, microhardness

2. **Phase Transformation Effects During HIP of Titanium Aluminide (TiAl).**
Schaefer, R. J., Janowski, G. M.
Acta Metall Mater 40 (7), 1645-51, 1992
Key Words: TiAl, phase transformation, densification

3. **Synthesis of Titanium Aluminide (TiAl) Intermetallic Compounds by HIP-Reaction Sintering**
Kakitsuji, A., Miyamoto, H.
Elsevier, London, UK
Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl 295-300, 1992
Key Words: TiAl, Ti(3)Al, reaction sintering, microstructure, grain size

4. **Powder Processing of Intermetallic Alloys and Intermetallic Matrix Composites**
Stoloff, N. S., Alman, D. E.
Mater Sci Eng A A144, 51-62, 1991
Key Words: Al(3)Ta, NiAl, Ni(3)Al, NbAl(3), TiAl, phase diagram, reactive sintering, densification, injection molding, reaction milling, mechanical alloying, Charpy impact, tensile properties

5. **Novel P/M Processing of Intermetallic Compound Using Amorphous TiAl**
Kimura, H., Kobayashi, S.
The Japan Institute of Metals, Sendai, Japan
Proc Intermetallic Compounds-Structure and Mechanical Properties (JIMIS-6)
985-9, 1991
Key Words: TiAl, amorphous alloy, hardness, processing, microstructure

6. **Formability of Hiped TiAl at Elevated Temperatures**
Bolt, P. J., Horihata, M., Ohuchi, K., Sano, T., Matsuno, K.
The Japan Institute of Metals, Sendai, Japan
Proc Intermetallic Compounds-Structure and Mechanical Properties (JIMIS-6)
953-7, 1991
Key Words: TiAl, compressive properties, three point bend, self-propagating high-temperature synthesis

7. **Microstructure and Mechanical Properties of Reactive Hot Isostatic Pressed TiAl Powder Material**
Smarsly, W. G., Dahms, M.
The Japan Institute of Metals, Sendai, Japan
Proc Intermetallic Compounds-Structure and Mechanical Properties (JIMIS-6)
947-52, 1991
Key Words: TiAl, aerospace applications, microstructure, hardness, tensile properties, bend test

8. **Processing and Properties of Gamma Titanium Aluminide Sheet Produced from Prep Powder**
Ohls, M. A., Nachtrab, W. T., Roberts, P. R.
Metal Powder Industries Federation, Princeton, NJ
Proc Symp P/M in Aerospace and Defense Technologies, 289-96, 1991
Key Words: TiAl, materials comparison, PREP, microstructure, tensile properties

9. **The Mechanical Properties of the Hot Pressed Compacts of TiAl Powder Produced by Plasma Rotating Electrode Process**
Tokizane, M., Isonishi, K., Kido, S.
PM Into the 1990's 2, 93-6, 1990
Key Words: TiAl, PREP, ball milling compressive properties, microstructure

10. **Processing of TiAl Structural Parts by Reaction HIP of Precompacted Elemental Powders**
Smarsly, W. G., Dahms, M., PM Into the 1990's 2, 86-92, 1990
Key Words: TiAl, structural parts, airframes, turbine components, extrusion, reactive hipping

11. **Mechanical Properties of Sintered TiAl Prepared by Canning Hipping**
Nakamura, M., Kaieda, Y., Powder Metall 33 (2), 133-9, 1990
Key Words: TiAl, grain size, impurities, crack growth, fracture surface, compressive properties, three point bend, bend strength, work hardening

12. **Powder Processing of High Temperature Aluminides**
German, R.M., Bose, A., Stoloff, N.S.
Materials Research Society, Pittsburgh, PA
Proc Symp High-Temperature Ordered Intermetallic Alloys III
133, 403-14, 1989 (AD-D143 438)
Key Words: NiAl, TiAl, NbAl(3), Ta(2)Al(4),TaAl(3), microstructure, tensile properties

13. **Powder Metallurgy of Titanium Aluminides**
Moxson, V. S., Friedman, G. I.
Met Powder Rept 43 (2), 88-91, 1988 (AD-D138 291)
Key Words: TiAl, microstructure, fracture, tensile properties, REP, bimetal joining

14. **Microstructure and Mechanical Properties of Sintered TiAl**
Nakamura, M., Kaieda, Y.
Powder Metall 31 (3), 201-9, 1988 (AD-D140 014)
Key Words: TiAl, microstructure, compressive properties, hardness, sintering, atomization, bend properties

15. **Consolidation of Rapidly Solidified Intermetallic Powders Using the Ceracon (R) Process**
Levi, C. G., Mehrabian, R., Oslin, B., Anderson, R. L., Sastry, S. M. L.
J Mater Shaping Technol 6 (2), 125-32, 1988 (AD-D140 650)
Key Words: TiAl, microstructure, phase diagram, consolidation, REP, rapid solidification

16. **Powder Metallurgy of Titanium Aluminide Components**
Yolton, C. F., Lizzi, T., Chandhok, V. K , Moll, J. H.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Titanium, Rapid Solidification Technology 263-71, 1986 (AD-D138 900)
Key Words: TiAl, turbine components, creep rupture, tensile properties, plastic deformation

17. **Alloys Based on NiAl for High Temperature Applications**
Vedula, K., Pathare, V., Aslandis, I., Titran, R. H.
National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Technical Memorandum
Rept No : NASA-TM-86976, 13 pp., 1984 (AD-D134 342)
Key Words: TiAl, grain size, strengthening, flow stress, compressive properties, hot extrusion

18. **Intermetallic Phases in the Copper/Titanium-6-6-2 Alloy System for the XM-785 Rotating Band**
Shappirio, J. R., Calella, P. C., Eckart, D. W.
Army Electronics Technology and Devices Lab., Fort Monmouth, NJ
Research and Development Technical Report
Rept No : DELET-TR-83-1, 16 pp., 1983 (AD-B074 322L)
Key Words: TiAl, Ti-6Al-6V-2Sn, dissimilar joining, diffusion bonding

Miscellaneous Intermetallic Compounds

1. **Microstructure and Mechanical Properties of HIPed compacts of Mechanically Alloyed Titanium-Aluminum Powder**
Park, Y. H., Hashimoto, H., Watanabe, R., Ahn, J. H., Chung, H. S.
Mater Sci Forum, 88-90, 155-62, 1992
Key Words: TiAl, Ti(3)Al, Al(3)Ti, mechanical alloying, ball milling, microstructure, mechanical properties, microhardness

2. **HIP Consolidation of Aluminum-Rich Intermetallic Alloys and Their Composites**
Frazier, W. E., Donnellan, M. E.
Naval Air Warfare Center, Aircraft Div, Warminster, PA
Final Report, Sep. 1990-Sep. 1991
NAWCADWAR-92003-60, 28 pp., 1992 (AD-A251 429)
Key Words: Al(3)Ti, aircraft structures, tensile properties, crystal structure, copper addition, melting point

3. **Microstructure and Tensile Properties of Fe(3)Al Produced by Combustion Synthesis/Hot Isostatic Pressing**
Rabin, B. H., Wright, R. N.
TMS, Warrendale, PA
Metall Trans 23A, 35-40, 1992
Key Words: Fe(3)Al, tensile properties, microstructure, combustion synthesis

4. **Intelligent Hip Processing of Intermetallic Alloys**
Naval Air Warfare Center, Warminster, PA
Quarterly Progress Report Number One
Contract No : N62269-91-C-0247
Rept No : BDM/VAS-0746-91-TR, 15 pp., 1991 (AD-B161 960)
Key Words: intermetallic compounds, turbine components, processing, microstructure, densification, near net shape forming, finite element analysis, control systems

5. **Microstructure Control of Titanium Aluminide Powder Compacts by Thermochemical Processing**
Apgar, L. S., Eylon, D.
Iron Steel Inst Jpn Inter 31 (8), 915-21, 1991
Key Words: Ti-24Al-11Nb, microstructure, PREP, thermomechanical treatment, hydrogenation, phase diagram, superplasticity

6. **Structure and Some Properties of Electrolytic Powdered Intermetallics of Titanium and Iron**
Zarubitskaya, L. I., Korobka, Yu. V.
Plenum Press, New York, NY
Sov Powder Metall Met Ceram 30 (3), 167-8, 1991
Key Words: TiFe, hydrogen power generation, sintering, electrolytic powder, hydrogen capacity

7. **Powder Processing of Intermetallic Alloys and Intermetallic Matrix Composites**
Stoloff, N. S., Alman, D. E.
Mater Sci Eng A A144, 51-62, 1991
Key Words: Al(3)Ta, NiAl, Ni(3)Al, NbAl(3), TiAl, phase diagram, reactive sintering, densification, injection molding, reaction milling, mechanical alloying, Charpy impact, tensile properties

8. **Intrinsic Second-Phase Particles in Powder-Processed MoSi(2)**
Cotton, J. D., Kim, Y. S., Kaufman, M. J.
Mater Sci Eng A A144, 287-91, 1991
Key Words: MoSi(2), hot pressing, arc melting, inclusions, fracture grain growth, carbon addition

9. **Reactive Sintering and Reactive Hot Isostatic Pressing of Iron Aluminides**
Bose, A., Page R. A., Misiolek, W., German, R. M.
Adv Powder Metall 6, 131-45, 1991
Key Words: Fe(3)Al, density, powder size, sintering temperature

10. **P/M Processing of Titanium Aluminides**
Moll, John H., Yolton, C. F., McTiernan, B. J.
Int J Powder Metall 26 (2), 149-55, 1990
Key Words: Ti(3)Al, Ti-25Al-10Nb-3V-1Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-48 at pct Al-1 at pct V, microstructure, particle size, tensile properties, stress rupture, plasma spraying

11. **Densification of Rapidly Solidified Titanium Aluminide Powders-II. The Use of a Sensor to Verify Hiping Models**
Choi, B. W., Marschall, J., Deng, Y. G., McCullough, C., Paden, B., Mehrabian, R.
Acta Metall Mater 38 (11), 2245-52, 1990 (AD-D144 155)
Key Words: Ti-48 at pct Al-2.5 at pct Nb, Ti-50 at pct Al-2 at pct Nb, atomization, density, densification, rapid solidification, REP

12. **Densification of Rapidly Solidified Titanium Aluminide Powders-I Comparison of Experiments to Hiping Models**
Choi, B. W., Deng, Y. G., McCullough, C., Paden, B., Mehrabian, R.
Acta Metall Mater 38 (11), 2225-43, 1990 (AD-D144 154)
Key Words: Ti-48 at pct Al-2.5 at pct Nb, Ti-50 at pct Al-2 at pct Nb, atomization, particle size, grain size, consolidation, rapid solidification, REP, density

13. **Fabrication of the D0(22)-Type Intermetallic Compound Al3Ta via Powder Metallurgy Processes and its Characterization**
Pak, H. R., Pak, J. S. L., Rigsbee, J. M., Wayman, C. M.
Mater Sci Eng A A128 (1), 129-39, 1990 (AD-D144 120)
Key Words: Al(3)Ti, aluminum, tantalum, crystal structure, lattice parameters, phase diagram, density, dislocations, grain boundaries, deformation, fabrication

14. **Fabrication of Intermetallic Compounds by Solid State Reaction of Roll-Bonded Materials**
Fishman, S. G., Martin Marietta Astronautics Group, Denver, CO
Rept No : MCR-85-721, 6 pp., 1990 (AD-A229 386)
Key Words: Ti(2)Be(17), TiBe(12), microstructure, fracture surface, tensile properties, foil, roll bonding, fabrication

15. **Modelling of Hipping Consolidation Applied to Ni(3)Al Powders**
Wright, R. N., Williamson, R. L., Knibloe, J. R.
Powder Metall 33 (3), 253-9, 1990
Key Words: Ni(3)Al, Ni-19 at pct Al-8.5 at pct Cr, grain boundary diffusion, creep, tensile properties, atomization

16. **Powder Processing of High Temperature Aluminides**
German, R.M., Bose, A., Stoloff, N.S.
Materials Research Society, Pittsburgh, PA
Proc Symp High-Temperature Ordered Intermetallic Alloys III
133, 403-14, 1989 (AD-D143 438)
Key Words: NiAl, TiAl, NbAl(3), Ta(2)Al(4),TaAl(3), microstructure, tensile properties

17. **High Temperature Intermetallics by Powder Processing**
Bose, A., Moore, B., Stoloff, N.S., German, R.M.
MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
Proc Int Conf PM Aerospace Materials-87, 4.1-4.13, 1988 (AD-D143 658)
Key Words: NiAl, Nb(3)Al, phase diagram, elongation, tensile properties

18. **Effect of Hydrostatic Pressure on the Sintering Behavior and Density of Blended Elemental TiNi Compacts**
Uehara, S., Sasano, H., Kaieda, Y., Suzuki, T.
Powder Metall Int 17 (5), 229-32, 1985 (AD-D134 086)
Key Words: TiNi, microstructure, microprobe analysis, martensitic transformation, density

19. **P/M Processing of Intermetallic Compounds of CsCl Type for High Temperature Applications**
Vedula, K., Anderson, G., Pathare, V., Aslandis, I.
Metal Powder Industries Federation, Princeton, NJ
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Key Words: FeAl, NiAl, hot extrusion, creep, compressive properties

20. **Progress of Powder Metallurgy in North America**
Roll, K.H., Johnson, P.K.
Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

21. **The Effect of Grain Size on the High Temperature Plastic Deformation of Nb(3)Sn**
Clark, J. B., Hopple, G. B., Wright, R. N.
Metall Trans 14A (5), 889-94, 1983 (AD-D127 250)
Key Words: Nb(3)Sn, compressive properties, grain size, creep, plastic deformation, activation energy

22. **Materials Research for Advanced Inertial Instrumentation. Task 3. Rare Earth Magnetic Material Technology as Related to Gyro Torquers and Motors**
Das, D., Kumar, K.
Charles Stark Draper Lab Inc., Cambridge, MA
Technical Report
Rept No : CSDL-R-1614, TR-5, 73 pp., 1982 (AD-A126 982)
Key Words: SmCo(5), plasma spraying, sintering, arc spraying

23. **Materials Research for Advanced Inertial Instrumentation, Task 3: Rare Earth Magnetic Material Technology as Related to Gyro Torquers and Motors**
Das, D., Kumar, K., Wettstein, E.
Charles Stark Draper Lab Inc., Cambridge, MA
Research Report
Rept No : CSDL-R-1529, TR-4, 70 pp., 1981 (AD-A114 955)
Key Words: Sm(5)Co, thermal expansion, x-ray diffraction, plasma deposition

24. **Rolling, Forming and Joining Titanium-Aluminide Sheet**
Bhatt, D. D., Meyer, G. E., Hoffmanner, A. L.
Battelle Memorial Institute, Columbus, OH
Final Report
Rept No : AFML-TR-78-59, 130 pp., 1978 (AD-B031 214)
Key Words: Ti-16Al-10Nb, Ti-12Al-19Nb, Ti-13Al-20Nb, Ti-36Al-5Nb, Ti-32Al-5Nb-5W, rolling, superplastic forming, joining, tensile properties, hardness, fatigue, creep test, bend test

REFACTORY METALS AND ALLOYS

Molybdenum Alloys

1. **Structure and Mechanical Properties of Mo-ZrO(2) Materials Densified by HIP**
   Muramatsu, Y., Funami, K., Halada, K., Hoshimoto, K.
   J Jpn Inst Met 52 (8), 803-9, 1988 (AD-D139 796)
   Key Words: Molybdenum alloys, microstructure, flexural properties, fracture toughness, transformation toughening

2. **Sintering Behavior and Mechanical Properties of Activated Sintered Molybdenum**
   Hofmann, H., Grosskopf, M., Hofmann-Amtenbrink, M., Petzow, G.
   Powder Metall 29 (3), 201-6, 1986 (AD-D135 749)
   Key Words: molybdenum alloys, nickel addition, microstructure, bend properties

3. **New Powder Technologies for Molybdenum Alloy Gun Barrel Liners**
   Barranco, J. M., Isserow, S.
   Large Caliber Weapon Systems Lab, Army Armament and Development Center, Watervliet, NY
   Final Technical Report
   Rept No : ARLCB-TR-85017, 42 pp., 1985 (AD-A158 315)
   Key Words: gun barrels, REP, erosion resistance, hardness, bend test, tensile properties, creep rupture, compressive properties, fracture, molybdenum alloys

4. **The Densification of Molybdenum and Molybdenum Alloy Powders Using Hot Isostatic Pressing**
   Barranco, J., Ahmad, I., Isserow, S., Warenchak, R.
   Large Caliber Weapon Systems Lab, Army Armament and Development Center, Watervliet, NY
   Final Technical Report
   Rept No : ARLCB-TR-85025, 66 pp., 1985 (AD-A159 886)
   Key Words: gun barrels, microscopy, compressive properties, REP, fracture, plasma deposition, molybdenum alloys

5. **Reduced Grain Boundary Mobility and the Sintering of Molybdenum**
   German, R. M.,
   Rensselaer Observatory, Troy, NY
   Final Report
   Contract No : DAAG29-81-K-0152
   12 pp., 1984 (AD-A140 265)
   Key Words: molybdenum alloys, nickel addition, grain boundaries, liquid sintering

6. **Processing: The Rediscovered Dimension in High Temperature Alloys**
   Semchyshen, M.
   Standardization News 4 (4), 9-19, 1976 (AD-D110 676)
   Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

7. **Interdiffusion Behavior of Tungsten or Rhenium and Group V and VI Elements and Alloys of the Periodic Table-Part II (Appendices)**
Arcella, F. G., Westinghouse Astronuclear Lab, Pittsburgh, PA
Rept No : WANL-M-FR-74-005, 147 pp., 1974 (AD-D100 713)
Key Words: Nb-1Zr, W-30Re-20Mo, Mo-50Re, T-111, Ta-10W, niobium, tungsten, tantalum, porosity, dissimilar joining, weldability, fracture mechanics, cracking, degradation, diffusivity, interdiffusion

Niobium and Niobium Alloys

1. **Rapid Solidification Processing of Niobium Alloys**
Jha, S. C., Ray, R.
Met Powder Rept 43 (2), 96-9, 1988 (AD-D138 293)
Key Words: Nb-10Hf, WC-103, microstructure, grain size, dispersoids, tensile properties

2. **Alternate Processing Concepts for P/M Columbium Alloys**
Friedman, G. I.
TRW Inc., Materials Technology, Cleveland, OH
Rept No : TRW-ER-8249-F, 43 pp., 1983 (AD-B077 405L)
Key Words: C-103, niobium alloys, forging, tensile properties welding, scrap reclaimation

3. **Pressing of Powder Materials (Selected Pages)**
Umanskiy, A. M.
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1399-81, 31 pp., 1982 (AD-B062 478L)
Key Words: tungsten alloys, niobium alloys, steels, press forging, density, shrinkage

4. **Creep Behavior of Hot Isostatically Pressed Niobium Alloy Powder Compacts**
Wadsworth, J., Robert, C. A., Rennhack, E. H.
J Mater Sci 17 (9), 2539-46, 1982 (AD-D125 985)
Key Words: C-103, microstructure, creep, tensile properties

5. **Interdiffusion Behavior of Tungsten or Rhenium and Group V and VI Elements and Alloys of the Periodic Table-Part I**
Arcella, F. G.
Westinghouse Astronuclear Lab, Pittsburgh, PA
Rept No : WANL-M-FR-74-005, 248 pp., 1974 (AD-D100 645)
Key Words: tantalum, niobium, tungsten, T-111, rhenium, dissimilar joining, electron beam welding, pressure bonding, interdiffusion, voids, aging, mathematical model, niobium alloys

6. **Interdiffusion Behavior of Tungsten or Rhenium and Group V and VI Elements and Alloys of the Periodic Table-Part II (Appendices)**
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Key Words: Nb-1Zr, W-30Re-20Mo, Mo-50Re, T-111, Ta-10W, niobium, tungsten, tantalum, porosity, dissimilar joining, weldability, fracture mechanics, cracking, degradation, diffusivity, interdiffusion

Tantalum and Tantalum Alloys

1. **Properties of Hot Isostatically Pressed Tantalum**
   Boncoeur, M., Valin, F., Raisson, G., Michaud, H.
   Elsevier, London, UK
   Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl, 247-52, 1992
   Key Words: tantalum, microstructure, mechanical properties, electron beam melting, near net shape

2. **Fabrication of the D0(22)-Type Intermetallic Compound Al3Ta via Powder Metallurgy Processes and its Characterization**
   Pak, H. R., Pak, J. S. L., Rigsbee, J. M., Wayman, C. M.
   Mater Sci Eng A A128 (1), 129-39, 1990 (AD-D144 120)
   Key Words: Al(3)Ti, aluminum, tantalum, crystal structure, lattice parameters, phase diagram, density, dislocations, grain boundaries, deformation, fabrication

3. **Hot Isostatic Processing**
   Hanes, H. D., Seifert, D. A., Watts, C. R.
   Metals Information Analysis Center, West Lafayette, IN
   Rept No : MCIC-77-34, 101 pp., 1977 (AD-A049 227)
   Key Words: T-111, Ti-6Al-4V, AA A356-T61, IN-738, RENE' 80, Udimet 700, IN-792, welding, tensile properties, pressure bonding

4. **Interdiffusion Behavior of Tungsten or Rhenium and Group V and VI Elements and Alloys of the Periodic Table-Part I**
   Arcella, F. G.
   Westinghouse Astronuclear Lab, Pittsburgh, PA
   Final Report
   Rept No : WANL-M-FR-74-005, 248 pp., 1974 (AD-D100 645)
   Key Words: tantalum, niobium, tungsten, T-111, rhenium, dissimilar joining, electron beam welding, pressure bonding, interdiffusion, voids, aging, mathematical model, niobium alloys

5. **Interdiffusion Behavior of Tungsten or Rhenium and Group V and VI Elements and Alloys of the Periodic Table-Part II (Appendices)**
   Arcella, F. G.
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   Key Words: Nb-1Zr, W-30Re-20Mo, Mo-50Re, T-111, Ta-10W, niobium, tungsten, tantalum, porosity, dissimilar joining, weldability, fracture mechanics, cracking, degradation, diffusivity, interdiffusion

Tungsten and Tungsten Alloys

1. **Hot Isostatic Pressing and Sintering Behavior of Yttrium Oxide Dispersed Tungsten**
   Ishiwata, Y., Itoh, Y., Kashiwaya, H.
   Elsevier, London, UK
   Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl 433-7, 1992
   Key Words: tungsten, yttrium oxide addition, sintering, density, bend strength

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Umanskiy, A. M.
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1399-81, 31 pp., 1982 (AD-B062 478L)
Key Words: tungsten alloys, niobium alloys, steels, press forging, density, shrinkage

3. **Processing and Characterization of Several Tungsten Alloys**
Hall, R. C., Ossin, A., Ammon, R. L., Buckman, R. W., Aronin, L.
Proc 20th National SAMPE Symp and Exhibition, 13 pp., 1975 (AD-D107 039)
Key Words: W-10Cu, W-2ThO2, W-4Re, W-0.5HfC, turbine components, leading edges, microstructure, tensile properties, thermal properties

4. **Interdiffusion Behavior of Tungsten or Rhenium and Group V and VI Elements and Alloys of the Periodic Table-Part I**
Arcella, F. G.
Westinghouse Astronuclear Lab, Pittsburgh, PA
Final Report
Rept No : WANL-M-FR-74-005, 248 pp., 1974 (AD-D100 645)
Key Words: tantalum, niobium, tungsten, T-111, rhenium, dissimilar joining, electron beam welding, pressure bonding, interdiffusion, voids, aging, mathematical model, niobium alloys

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Rept No : WANL-M-FR-74-005, 147 pp., 1974 (AD-D100 713)
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6. **Carbide Tools for Cold Extrusion**
Kennicott, W. L.
Met Eng Qtrly 13 (2), 15-8, 1973 (AD-181 411)
Key Words: tungsten alloys, compressive properties, creep rupture, fatigue, tooling

MISCELLANEOUS POWDER ALLOYS

1. **The Densification of Powders by Power-Lab Creep During Hot Isostatic Pressing**
   Duva, J. M., Crow, P. D.
   Acta Metall Mater 40 (1), 31-5, 1992
   Key Words: creep, densification, porosity, finite element analysis

2. **Technology of HIPing Complex Shape Parts With Dual Chemical Composition and Properties from Metal Powders: Trends of Its development in the USSR**
   Kratt, E. P., Samarov, V. N., Khaikin, R. A.
   Elsevier, London, UK
   Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl, 259-67, 1991
   Key Words: applications

3. **Die Forging of Powder Materials Under Conditions of High Hydrostatic Pressure**
   Bondarev, A. A., Yermanok, M. Z., Sobolyev, Yu. P.
   Foreign Technology Division, Wright-Patterson AFB, OH
   Rept No : FTD-ID(RS)T-0342-85, 14 pp., 1985 (AD B097 270L)
   Key Words: mechanical properties, plastic deformation, extrusion, heat treatment

4. **Progress of Powder Metallurgy in North America**
   Roll, K.H., Johnson, P.K.
   Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
   Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

5. **Al and Mg Alloys for Aerospace Applications Using Rapid Solidification and Powder Metallurgy Processing**
   Fraser, H. L.
   Department of Materials Science and Engineering, Illinois University at Urbana
   Annual Technical Report Number Two
   Rept No : AFOSR-TR-87-1584, 89 pp., 1981 (AD-A187 953)
   Key Words: Al-8Fe-2Mo, Mg-20Gd, Mg-1Si, Mg-2Si, Mg-3Si, Mg-4Si, Mg-5Si, Mg-8Si, Mg-5Li, Mg-12Li, Mg-5Li-5Si, Mg-8Li-5Si, Mg-12Li-5Si, aerospace applications, rapid solidification, melt spinning, tensile properties, precipitation, solution heat treatment

6. **A Retrospective View of Metallurgy During the 25 Years of the Gillett Lectures**
   Jaffee, R. I.
   Standardization News 5 (1), 9-22, 1977 (AD-D108 834)
   Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement, fracture mechanics

7. **HIP Fabrication of Experimental Mirror Substructure**
   Mueller, J. J.
   The Royal Society, London, UK
   Proc 4th Int Conf Beryllium Paper No. 34, 18 pp., 1977 (AD-D113 207)
   Key Words: beryllium, copper, mirror, coatings, temperature effect

8. **An Evaluation of Real and Programmed Defect Conditions in HIP Discs Using Holosonics' System 200 Scanned Acoustical Holography Imaging System**
Knuter, N. J.
Holosonics Inc., Richland, WA
Final Report
Rept No : USAAVSCOM-TR-76-25, 140 pp., 1976 (AD-A038 264)
Key Words: holography, acoustic emission, defects, nondestructive testing

9. ***Ductile-Brittle Transition of Thoriated Chromium***
Wilcox, B. A., Veigel, N. D., Clauer, A. H.
Metall Trans 3 (1), 273-83, 1972 (AD-D123 239)
Key Words: chromium, Cr-ThO2, tensile properties, microstructure, annealing

2. Castings

ALUMINUM ALLOYS

AA A201

1. **Effect of Hot Isostatic Pressure on Cast Alı ninum Airframe Components**
   Mocarski, S. J., Scarich, G. V., Wu, K. C.
   Trans Am Foundrymen's Soc 99, 77-81, 1991
   Key Words: AA A201-T7, aircraft structures, fatigue, tensile properties, fracture toughness

2. **Fracture Toughness and Fatigue Crack Growth Rate Testing of Premium Quality Vacuum Investment Cast 200 and 300 Series Aluminum Alloys**
   Bouse, G. K., Behrendt, M. R.
   Proc Int Conf Aluminum Alloys--Their Physical and Mechanical Properties.
   3, 1665-80, 1986 (AD-D140 112)
   Key Words: AA A201-T7, AA A206-T71, AA A357-T6, turbine components, airframes, crack growth rate, fracture toughness

3. **Hipping is One Way to Check Porosity in Cast Components**
   Irving, R. R., Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
   Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

4. **Hot Isostatic Pressing of Aluminum Alloy Castings**
   Vonk, S. J., Hoppin, G. S., Benn, K. W.
   Garrett Turbine Engine Co., Phoenix, AZ
   Rept No : 31-3968, 64 pp., 1981 (AD-A105 562)
   Key Words: AA A201, porosity, microstructure, tensile properties, fatigue

5. **Advanced Aluminum Metallic Materials and Processes for Application to Naval Aircraft Structures**
   Highberger, W. T., Scarich, G. V., Chanani, G. R.
   SAMPE, Azusa, CA
   Proc 12th National SAMPE Technical Conf 554-62, 1980 (AD-D127 131)
   Key Words: AA A201-T7, porosity, tensile properties, fatigue, crack growth rate

AA A356

1. **A Statistical Model for Predicting the Fracture of Silicon Particles in HIPed A356 Aluminum Castings**
   Chou, J. S., Meyers, C. W.
   Trans Am Foundrymen's Soc 99, 165-, 1991
   Key Words: AA A356, microcracking, porosity, plastic deformation

2. **Experimental Investigations of deformation in HIPped A356 aluminum castings**
   Meyers, C. W., Chou, J. S.
   Trans Am Foundrymen's Soc 99, 175-86, 1991
   Key Words: AA A356, casting, microstructure, fracture fracture toughness, tensile behavior, deformation

3. **Developing Aluminum-Lithium Alloys for Investment Casting**
Haynes, T. G., III, Tesar, A. M., Webster, D.
Modern Casting 76 (10), 26-8, 1986 (AD-D138 421)
Key Words: AA A356-T6, microstructure, fracture, tensile properties

4. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

5. **Improving Casting Properties and Integrity with Hot Isostatic Pressing**
Rooy, E. L.
Modern Casting 73(12), 18-20, 1983 (AD-D128 854)
Key Words: AA A356-T61, AA A357-T62, F132-T6, porosity, fatigue, tensile properties

6. **Hipping is One Way to Check Porosity in Cast Components**
Irving, R. R., Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

7. **Cutting Metal Loss Tied to Near Net Shapes**
Harvey, R. E. Iron Age 222 (42), 57-63, 1979 (AD-D116 853)
Key Words: RENE' 77, IN-738, IN-792, AA C355-T6, AA A356-T61 142-T6, net shape forming, fatigue, tensile properties

8. **Improved Properties in Castings by Hot Isostatic Pressing**
Glenn, G. M.
SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355 porosity, tensile properties, microstructure, creep rupture, density, fatigue

9. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
Mueller, J. J.
Electric Power Research Inst, Palo Alto, CA
Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

AA A357

1. **Fracture Toughness and Fatigue Crack Growth Rate Testing of Premium Quality Vacuum Investment Cast 200 and 300 Series Aluminum Alloys**
Bouse, G. K., Behrendt, M. R.
Proc Int Conf Aluminum Alloys--Their Physical and Mechanical Properties 3, 1665-80, 1986 (AD-D140 112)
Key Words: AA A201-T7, AA A206-T71, AA A357-T6, turbine components, airframes, crack growth rate, fracture toughness

2. **Correction of Casting Faults by the Hot Isostatic Pressing of High Strength Aluminum Materials**
Zeitler, H., Scharfenberger, W.
Aluminum English 60 (12), E803-8, 1984 (AD-D131 723)
Key Words: AA A357-T6, fracture defects, porosity, sand casting

3. **Improving Casting Properties and Integrity with Hot Isostatic Pressing**
Rooy, E. L.
Modern Casting 73(12), 18-20, 1983 (AD-D128 854)
Key Words: AA A356-T61, AA A357-T62, F132-T6, porosity, fatigue, tensile properties

4. **Development and Demonstration of Economic Production Systems in Airframe Construction. Part 2: Technological Phase. Part 6: Review**
NTIS, N84-23555, Springfield, VA
Final Report, Dec 80-Jun 83
Rept No : N84-23555, 152 pp., 1983 (AD-D134 719)
Key Words: AA A357, titanium alloys, fracture mechanics, diffusion bonding, fatigue

5. **HIP, the Great Healer of Castings**
Bittence, J. C.
Mater Eng 88 (4), 54-7, 1978 (AD-D113 844)
Key Words: Inconel 718, IN-792, Ti-6Al-4V, 17-4PH, AA A357, porosity, fatigue, creep properties, deformation, cost

6. **High Integrity Casting Program**
Schweikert, W. H.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 392-405, 1976 (AD-D119 186L)
Key Words: Inconel 718, Ti-6Al-4V, 17-4PH, AA A357, tensile properties, nondestructive testing

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1. **Effect of Heat Treatment and Hot Isostatic Pressing on Void Density and Fracture Mode of Al(67)Ni(8)Ti(25)**
Mysko, D.D., Lumsden, J.B., Powers, W.O., Wert, J.A.
Scr Metall 23(11), 1827-30, 1989 (AD-D143 812)
Key Words: Al-8N-25Ti, electrode arc melting, microstructure, heat treatment, transgranular fracture, voids

2. **The Mechanical Properties of Superplastically Formed Titanium and Aluminum Alloys**
Partridge, P. G., McDarmaid, D. S., Bottomley, I., Common, D.
Royal Aircraft Establishment Farnborough, UK
AGARD Lecture Series, Superplasticity AGARD-LS-154
6-1 to 6-23, 1987 (AD-D139 987)
Key Words: Ti-6Al-4V, AA 7475, Supral 100, Supral 150, Supral 220, alclad coatings, microstructure, grain size, aging, elastic properties, fatigue, fracture toughness

3. **Hot Isostatic Pressing of Aluminum-Silicon Castings**
Chama, C. C.
Pennsylvania State University, Dept. of Materials Science and Engineering, University Park, PA
Dissertation
275 pp., 1986 (AD-D139 361)
Key Words: Al-7Si, Al-10Si, porosity, tensile properties

4. **Fracture Toughness and Fatigue Crack Growth Rate Testing of Premium Quality Vacuum Investment Cast 200 and 300 Series Aluminum Alloys**
Bouse, G. K., Behrendt, M. R.
Proc Int Conf Aluminum Alloys--Their Physical and Mechanical Properties.
3, 1665-80, 1986 (AD-D140 112)
Key Words: AA A201-T7, AA A206-T71, AA A357-T6, turbine components, airframes, crack growth rate, fracture toughness

5. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

6. **Manufacturing Technology for Cast Aluminum Alloy Compressor Housings**
Johnson, C. A.
Naval Weapons Center, China Lake, CA
Final Report Mar 81-May 84
Rept No : NWC-TP-6603, 40 pp., 1985 (AD-B101 621L)
Key Words: AA 6061-T6, 15-5PH, tensile properties, fracture, metallography, bend test, burst test

7. **Improving Casting Properties and Integrity with Hot Isostatic Pressing**
Rooy, E. L.
Modern Casting 73(12), 18-20, 1983 (AD-D128 854)
Key Words: AA A356-T61, AA A357-T62, F132-T6, porosity, fatigue, tensile properties

8. **Application of the HIP Process to Aluminum and its Alloys**
Hofer, B.
Aluminum English 59 (12), E536-8, 1983 (AD-D129 047)
Key Words: Al-10Si, Al-4Cu, Al-7Si, diffusion, bonding, porosity, net shape forming, mechanical properties

9. **Treatment Processes of Light and Heat Resistant Alloys**
Belov, A. F., Tselikov, A. I., Trishkin, V. G., Rakovskiy, V. S., Rykalin, N. N.
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-0412-82, 335 pp., 1982 (AD-B070 680L)
Key Words: aluminum alloys, titanium alloys, mechanical properties, fatigue, cracking

10. **Porous Castings? HIPping Might be Your Answer**
Widmer, R., Price, P. E.
Modern Casting 72 (8), 42-3, 1982 (AD-D125 344)
Key Words: Ti-6Al-4V, stainless steel, aluminum alloys, porosity, rejuvenation, cost

11. **Hipping is One Way to Check Porosity in Cast Components**
Irving, R. R.
Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN 738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

12. **The Development of Aluminum-Lithium Alloys**
Gayle, Frank W.
Reynolds Metals Co., Metallurgical Research Division, Richmond, VA
Final Report
Contract No.: N00019-78-C-0485
178 pp., 1980 (AD-A090 138)
Key Words: Al-(2-3)Li, scandium addition, gallium addition, manganese addition, magnesium addition, silver addition, copper addition, iron addition, dispersion hardening, microstructure, hardness, tensile properties

13. **Trends in Casting Technology**
Chandler, H. E., Baxter, D. F.
Metal Prog 117 (1), 97-9, 1980 (AD-D117 224)
Key Words: AA 6061-T6, AISI 4340, Fe-3C-19Cr-1.5Ni-2Mo, tensile properties

14. **Cutting Metal Loss Tied to Near Net Shapes**
Harvey, R. E.
Iron Age 222 (42), 57-63, 1979 (AD-D116 853)
Key Words: RENE' 77, IN-738, IN-792, AA C355-T6, AA A356-T61, 142-T6, net shape forming, fatigue, tensile properties

15. **Casting High-Performance, High-Integrity Components**
Heine, H. J.
Foundry Manage Technol 105 (3), 88-96, 1977 (AD-D108 804)
Key Words: Ti-6Al-4V, 18/8 stainless, 18Cr-10Ni, AA A360, B1914, B1925, B1964, B1981, airframes, aircraft structures, creep rupture, stress analysis, nondestructive testing, tensile properties, tribaloy

16. **Improved Properties in Castings by Hot Isostatic Pressing**
Glenn, G. M.
SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355 porosity, tensile properties, microstructure, creep rupture, density, fatigue

BERYLLIUM AND BERYLLIUM ALLOYS

1. **Characteristics of Mechanically Fastened Joints of CIP/HIP-1 Beryllium**
   Chou, S-C., Rainey, J. H., Swanson, R. A.
   Army Materials and Mechanics Research Center, Watertown, MA
   Final Report
   Rept No : AMMRC-TR-79-48, 37 pp., 1979 (AD-A078 275)
   Key Words: beryllium, bearing strength, stress-strain, stress analysis

2. **Materials Research for Advanced Inertial Instrumentation. Task 2. Gas Bearing Material Development by Surface Modification of Beryllium**
   Das, D., Kumar, K., Wettstein, E., Wollam, J.
   Charles Stark Draper Lab Inc., Cambridge, MA
   Technical Report Number Two
   Rept No : R-1330, 70 pp., 1979 (AD-A084 780)
   Key Words: beryllium alloys, ion implantation, boride coatings, plasma deposition

3. **Containerless Processing of Beryllium Experiment 74-48**
   Wouch, G., Keith, G. H., Frost, R. T., Pinto, N.P.
   General Electric Co., Space Div, Philadelphia, PA
   Final Report
   Rept No : N77-27211, 65 pp., 1977 (AD-D111 224)
   Key Words: beryllium, beryllium oxide addition, grain structure, space processing, zero gravity environment, thermal analysis

4. **Creep Mechanisms in Beryllium**
   Webster, D., Crooks, D. D.
   Metall Trans 7A (9), 1307-15, 1976 (AD-D107 626)
   Key Words: beryllium, RR243, BSP9, T30, 9776, 9713, 8084, EF1, creep properties, cracking, grain boundaries, plastic deformation

COBALT ALLOYS

MAR-M509

1. **Fatigue Dominated Damage Processes**
   Bressers, J., Remy, L., Hoffelner, W.
   Kluwer Academic Publishers, Norwell, MA
   Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1
   441-68, 1986 (AD-D142 075)
   Key Words: MAR-M509, IN-738LC, Hastelloy X, Inconel 617, RA-333, A-286, Inconel 718, Incoloy 901, microstructure, cracking, granular fracture, fatigue

2. **Aircraft Gas Turbine Materials and Processes**
   Kear, B. H., Thompson, E. R.
   Science 208 (4446), 847-56, 1980 (AD-D126 322)
   Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

3. **Quality of Castings of Superalloys**
   Bachelet, E., Lesoult, G.
   Applied Sciences Publishers Ltd., London, UK
   High Temperature Alloys for Gas Turbines 665-99, 1978 (AD-D116 360)
   Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

4. **Cost/Benefit Analysis of Advanced Materials Technologies for Future Aircraft Turbine Engines**
   Bisset, J. W.
   United Technologies Corp., East Hartford, CT
   Rept No : N77-14026, PWA-5453, 42 pp., 1976 (AD-D107 956)
   Key Words: MAR-M509, Hastelloy X, Waspaloy, IN-100, MAR-M200, turbine components, single crystals, hafnium addition, unidirectional solidification, cost

5. **Study of Superalloys Produced via Powder Metallurgy**
   Hellner, L., Johansson, H., NTIS, N77-13210, Springfield, VA
   Rept No : N77-13210, 56 pp., 1975 (AD-D109 492)
   Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking, microstructure, temperature effect, deformation, stress intensity, tensile properties

6. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
   Grant, N. J., Pelloux, R. M., Regis, M. N., Flemings, M. C., Merton, C.
   Argon, A. S.
   Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
   Semi-Annual Technical Report Number Three Jul-Dec 1971
   Contract No : DAHC15-70-C-0283
   130 pp., 1972 (AD-739 340)
   Key Words: IN-100, MAR-M509, Maraging 300, microstructure, tensile properties, fatigue, hardness, creep rupture, fracture toughness

X-40

1. **Microstructural Damages Induced During the Repair Process**
   Davin, A., Lecomte-Mertens, Ch., Vierset, P., Louis, P.
   Kluwer Academic Publishers, Norwell, MA
   Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part I
   811-20, 1986 (AD-D142 085)
   Key Words: Haynes 188, MAR-M200, X-40, turbine components, tensile properties, thermal shock, diffusion brazing, rejuvenation, repairs, welding

2. **Repair and Rejuvenation Procedures for Aero-Gas-Turbine Hot-Section Components**
   Bell, S. R.
   Mater Sci Technol 1 (8), 629-34, 1985 (AD-D133 818)
   Key Words: Nimonic 108, RENE' 100, Nimocast PD21, X-40, C1023, turbine components, repair welding, microstructure, rejuvenation, creep

3. **Aircraft Gas Turbine Materials and Processes**
   Kear, B. H., Thompson, E. R.
   Science 208 (4446), 847-56, 1980 (AD-D126 322)
   Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

4. **Quality of Castings of Superalloys**
   Bachelet, E., Lesoult, G.
   Applied Sciences Publishers Ltd., London, UK
   High Temperature Alloys for Gas Turbines 665-99, 1978 (AD-D116 360)
   Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

5. **Study of Superalloys Produced via Powder Metallurgy**
   Hellner, L., Johansson, H.
   NTIS, N77-13210, Springfield, VA
   Rept No : N77-13210, 56 pp., 1975 (AD-D109 492)
   Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking, microstructure, temperature effect, deformation, stress intensity, tensile properties

Miscellaneous Cobalt Alloys

1. **Microstructural Damages Induced During the Repair Process**
   Davin, A., Lecomte-Mertens, Ch., Vierset, P., Louis, P.
   Kluwer Academic Publishers, Norwell, MA
   Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part I
   811-20, 1986 (AD-D142 085)
   Key Words: Haynes 188, MAR-M200, X-40, turbine components, tensile properties, thermal shock, diffusion brazing, rejuvenation, repairs, welding

2. **Long Term Materials Test Program: Materials Evaluation--Improved Simulation Tests**
Brobst, R. P., McCarron, R. L., Beltran, A. M., Spriggs, D. R., Grzybowski, D. F.
General Electric Co., Energy Systems Programs Department, Schenectady, NY
Technical Report
Rept No : DE82-000649, 54 pp., 1981 (AD-D125 182)
Key Words: FSX-414, IN-738, GTD-111, turbine components, coatings, erosion, hot corrosion

3. **Aircraft Gas Turbine Materials and Processes**
Kear, B. H., Thompson, E. R.
Science 208 (4446), 847-56, 1980 (AD-D126 322)
Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

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Applied Sciences Publishers Ltd., London, UK
High Temperature Alloys for Gas Turbines 665-99, 1978 (AD-D116 360)
Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

5. **New Superalloys, Better Processing Promise More Durable Turbine Parts**
Mishka, K. H.
Mater Eng 84 (3), 22-4, 1976 (AD-D104 639)
Key Words: MA956E, CAPIVAC IV, Pyromet CTX-1, Haynes 556, Haynes 8077, MA754E, MA757E, turbine components, zirconium coatings, tensile properties, creep rupture, thermal processing, thermal fatigue, oxidation, gamma prime, oxide dispersion strengthening

6. **Effect of Autoclave Heat Treatments on the Mechanical Properties of the Prealloyed Powder Cobalt-Base Alloy HS-31**
Freche, J. C., Ashbrook, R. L.
National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Technical Note
Rept No : NASA-TN-D-7117, 22 pp., 1973 (AD-181 092)
Key Words: HS-31, microstructure, heat treatment, creep rupture, tensile properties

IRON ALLOYS

17-4PH

1. **Influence of Processing Route on Fatigue Behavior of Investment Cast High Strength Steels**
   McCallum, R., Lang, W.
   NTIS, PB85-234813, Springfield, VA
   Technical Report
   Rept No : NEL-697, 35 pp., 1985 (AD-D135 646)
   Key Words: 17-4PH, EN40B, microstructure, fatigue, cracking

2. **Hipping: A Good Way to Improve Properties**
   Irving, R. R.
   Iron Age 224 (6), 77-81, 1981 (AD-D120 406)
   Key Words: JT-9D, MERL 76, 17-4PH, RENE' 120, IN-792, IN-738, turbine components, porosity

3. **HIP, the Great Healer of Castings**
   Bittence, J. C.
   Mater Eng 88 (4), 54-7, 1978 (AD-D113 844)
   Key Words: Inconel 718, IN-792, Ti-6Al-4V, 17-4PH, AA A357, porosity, fatigue, creep properties, deformation, cost

4. **High Integrity Casting Program**
   Schweikert, W. H.
   Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
   Proc Net Shape Metalworking Program Review 392-405, 1976 (AD-D119 186L)
   Key Words: Inconel 718, Ti-6Al-4V, 17-4PH, AA A357, tensile properties, nondestructive testing

5. **Precision Castings State-of-the-Art**
   Nagan, R. M.
   SAMPE Qtrly 6 (4), 1-7, 1975 (AD-D102 565)
   Key Words: 17-4PH, Hastelloy X, Inconel 718, Ti-6Al-4V, aircraft structures, turbine components, tensile properties

AISI 4340

1. **Trends in Casting Technology**
   Chandler, H. E., Baxter, D. F.
   Metal Prog 117 (1), 97-9, 1980 (AD-D117 224)
   Key Words: AA 6061-T6, AISI 4340, Fe-3C-19Cr-1.5Ni-2Mo, tensile properties

2. **Rare Earth Modified High Strength Steels via P/M Processing**
   Sheinker, A. A.
   TRW Inc., Materials Technology, Cleveland, OH
   Technical Report
   Rept No : TRW-ER-8097, 66 pp., 1979 (AD-A080 637)
   Key Words: AISI 4340, metallography, fractography, tensile properties, Charpy impact

3. **Complex Rotor Fabrication by Hot Isostatic Pressure Welding**
Lessman, G. G., Bryant, W. A.
Weld J 51 (12), 606s-614s, 1972 (AD-180 534)
Key Words: AISI 4340, Inconel 718, hardness, tensile properties

4. **Investigation of Solidification of High Strength Steel**
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2. **Materials for Advanced Turbine Engine--MATE**
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Mar-May 82
Contract No : NAS 3-20072
1982, 21 pp. (AD-D125 191)
Key Words: Hastelloy X, Incoloy 901, MA956, Udimet 700, MERL 76, turbine components, combustors, erosion, coatings, oxide dispersion strengthening

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Key Words: MERL 76, MA956, Hastelloy X, Incoloy 901, aircraft structures, combustor liners, turbine components, tensile properties, creep, crack growth, coatings, thermal fatigue

4. **New Superalloys, Better Processing Promise More Durable Turbine Parts**
Mishka, K. H.
Mater Eng 84 (3), 22-4, 1976 (AD-D104 639)
Key Words: MA956E, CAPIVAC IV, Pyromet CTX-1, Haynes 556, Haynes 8077 MA754E, MA757E, turbine components, zirconium coatings, tensile properties, creep rupture, thermal processing, thermal fatigue, oxidation, gamma prime, oxide dispersion strengthening

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15. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
Herman, H.
State University of New York at Stony Brook, Department of Materials Sciences, NY
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Irving, R. R.
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Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

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7. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
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Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

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NICKEL ALLOYS

Alloy 713

1. **Microstructure, Creep Properties, and Rejuvenation of Service-Exposed Alloy 713C Turbine Blades**
Maccagno, T. M., Koul, A. K., Immarigeon, J. P., Cutler, L., Allem, R. L'Esperance, G.
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Key Words: Alloy 713LC, MAR-M247, turbine components, microstructure, creep rupture, tensile properties, fatigue

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12. **Premium Quality Castings**
Freeman Jr., W. R.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
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Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue

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Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

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Kear, B. H., Thompson, E. R.
Science 208 (4446), 847-56, 1980 (AD-D126 322)
Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

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Key Words: B-1900, IN-792, Ti-6Al-4V, IN-100, tensile properties turbine components, fatigue, creep rupture

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Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

Hastelloy X

1. **Fatigue Dominated Damage Processes**
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Key Words: MAR-M509, Hastelloy X, Waspaloy, IN-100, MAR-M200, turbine components, single crystals, hafnium addition, unidirectional solidification, cost

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Nagan, R. M.
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Key Words: 17-4PH, Hastelloy X, Inconel 718, Ti-6Al-4V, aircraft structures, turbine components, tensile properties

7. **Manufacturing Methods for the Production of Disc Shapes by Contour Rolling**
Arnold, D. B.
General Electric Co., Aircraft Engine Group, Evendale, OH
Interim Engineering Progress Report Number Five, Apr-Jun 72
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Key Words: RENE' 95, Hastelloy X, AISI 304, AF 2-1DA, microstructure, hot rolling

IN-100

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by Heat Treatment and Hot Isostatic Pressing Techniques**
   Baldan, A.
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   Key Words: IN-100, Nimonic 80A, Nimonic 115, Nimonic 75, Nimonic 105, Nimonic 90, IN-738, IN-738LC, Inconel X-750, turbine components, creep, grain size, cavitation

2. **Deformation Mechanisms of Thermostructural Materials**
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   Key Words: IN-100, RENE' 80, turbine components, CoCrAl coatings, creep rupture, thermal fatigue, barrier coatings, dislocation

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   Key Words: IN-100, MERL 76, microstructure, swaging, creep rate, liquid sintering, creep rupture

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   Bell, S. R.
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   Key Words: Nimonic 108, RENE' 100, Nimocast PD21, X-40, C1023, turbine components, repair welding, microstructure, rejuvenation, creep

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   Key Words: IN-100, turbine components, microstructure, fatigue crack growth, rheocasting, tensile properties

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   Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain boundaries, porosity, creep rupture

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   Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine components, damage tolerance, EDM, creep, machining

8. **Fatigue Crack Initiation and Propagation in Several Nickel-Base Superalloys at 650**
Gayda, J., Miner, R. V.
Int J Fatigue 5 (3), 135-43, 1983 (AD-D127 868)
Key Words: Waspaloy, IN-100, RENE' 95, turbine components, fatigue, creep-fatigue, crack growth, porosity, fracture mechanics, tensile properties, microstructure,

9. **Overview of Temperature and Environmental Effects on Fatigue of Structural Metals**
Coffin, L. F.
Plenum Press, New York, NY
Proc 27th Sagamore Army Materials Research Conf 1-40, 1983 (AD-D131 509)
Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76, IN-100, NASA IIB-7, crack growth, fatigue

10. **HIP Processing--Potentials and Applications**
Van Der Vet, W. J.
Chromalloy American Co., Midwest City, OK
Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in Service of High Temperature Parts
11-1 to 11-16, 1982 (AD-D125 468)
Key Words: Inconel X-750, Udimet 500, RENE' 100, B-1900, Nimonic 105, IN-738, IN-782, turbine components, fatigue, thermal cycling, creep rupture

11. **Repair and Regeneration of Turbine Blades, Vanes, and Discs**
Huff, H., Wortmann, J.
Motoren und Turbinen Union GMBH, Munich, Germany
Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in Service of High Temperature Parts
13-1 to 13-7, 1982 (AD-D125 470)
Key Words: IN-100, Nimonic 90, Nimonic 108, turbine components, welding, creep, rejuvenation

12. **Superalloy Technology-Today and Tomorrow**
VerSnyder, F. L.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 1-49, 1982 (AD-D133 988)
Key Words: MAR-M200, IN-100, Udimet 700, carbon addition, boron addition, zirconium addition, cobalt addition, turbine components, corrosion, oxidation, REP, creep rupture, thermal fatigue

13. **Precision Casting of Turbine Blades and Vanes**
Drapier, J. M.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 887-908, 1982 (AD-D134 025)
Key Words: Alloy 713LC, IN-100, MAR-M200, PWA 1480, MAR-M247, CMSX2, turbine components, rejuvenation, oxidation, vacuum melting, unidirectional solidification

14. **Creep-Fatigue Environment Interactions in Superalloys**
Pelloux, R. M.
Massachusetts Institute of Technology, Department of Materials Science and Engineering, Cambridge, MA
Final Report
Rept No : AFOSR-TR-81-0450, 35 pp., 1981 (AD-A098 790)
Key Words: Udimet 700, Waspaloy, IN-100, microstructure, creep, fatigue, embrittlement

15. **Energy Efficient Engine. Volume 2. Appendix A: Component Development and Integration Program**
Moracz, D. J., Cook, C. R.
TRW Inc., Materials Technology, Cleveland, OH
Rept No : NASA-CR-173085, 200 pp., 1981 (AD-D134 362)
Key Words: Ti-6Al-4V, IN-100, seam welding, microstructure, diffusion bonding

16. **All Systems Are Go for Powder Metallurgy**
Irving, R. R.
Iron Age 223 (28), 41-5, 1980 (AD-D118 875)
Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

17. **HIP'ing Various Precision Cast Engine Components in Nickel-Based Superalloys**
Lamberigts, M., Diderrich, E., Coutsouradis, D., de Lamotte, E., Drapier, J. M.
Proc 4th Int Symp Superalloys, Superalloys 1980 285-94, 1980 (AD-D120 658)
Key Words: Alloy 713LC, IN-792, MAR-M002, MAR-M004, IN-100, jet engines, turbine components, creep, microstructure

18. **An Assessment of Hot Isostatic Pressing and Reheat Treatment for the Regeneration of Creep Properties of Superalloys**
Dennison, J. P., Elliot, I. C., Wilshire, B.
ASM International, Metals Park, OH
Proc 4th Int Symp Superalloys, Superalloys 1980 671-77, 1980 (AD-D120 696)
Key Words: Nimonic 105, IN-100, fracture mechanics, creep, heat treatment

19. **Aircraft Gas Turbine Materials and Processes**
Kear, B. H., Thompson, E. R.
Science 208 (4446), 847-56, 1980 (AD-D126 322)
Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

20. **HIP Rejuvenation of Damaged Blades**
Stewart, D. C., Bennett, G. T.
Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
Rept No : FR-11642, 115 pp., 1979 (AD-D108 398L)
Key Words: IN-100, MAR-M200, unidirectional solidification, creep properties, aluminides, PWA 73 coating, surface defects, rejuvenation

21. **The Promise of more Heat Resistant Turbine Materials**
Freche, J. C., Ault, G. M.
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Key Words: AF 2-1DA, AF-115, NASA IIB-7, NASA IIB-11, MAR-M200, MA6000E, WAZ-D, WAZ20, IN-100, service life, creep rupture, tensile properties, coatings, corrosion, thermal fatigue, unidirectional solidification

22. **Original HCl Surface Treatment for Diffusion Bonding of Nickel Superalloy Specimens**
Billard, D., Trottier, J. P.
Met Technol 5 (9), 309-19, 1978 (AD-D114 028)
Key Words: IN-100, Waspaloy, RENE' 95, Inconel 718, welding, grain size, bonding, recrystallization, temperature effect

23. **Quality of Castings of Superalloys**
Bachelet, E., Lesoult, G.
Applied Sciences Publishers Ltd., London, UK
High Temperature Alloys for Gas Turbines 665-99, 1978 (AD-D116 360)
Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

24. **HIP'ing Raises Casting Performance Levels**
Freeman, W. R., Jr.
Metal Prog 112 (3), 33-8, 1977 (AD-D110 513)
Key Words: B-1900, IN-792, Ti-6Al-4V, IN-100, tensile properties turbine components, fatigue, creep rupture

25. **Premium Quality Castings**
Freeman Jr., W. R.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 406-17, 1976 (AD-D119 187L)
Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue

26. **Cost/Benefit Analysis of Advanced Materials Technologies for Future Aircraft Turbine Engines**
Bisset, J. W.
United Technologies Corp., East Hartford, CT
Project Completion Report
Rept No : N77-14026, PWA-5453, 42 pp., 1976 (AD-D107 956)
Key Words: MAR-M509, Hastelloy X, Waspaloy, IN-100, MAR-M200, turbine components, single crystals, hafnium addition, unidirectional solidification, cost

27. **Materials and Processing Technology for Advanced Gas Turbines**
Hauser, H. A.
SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

28. **The Nature of the Sulfo-Carbides Observed in Nickel-Base Superalloys**
Wallace, W., Holt, R. T., Terada, T.
Metall 6 (6), 511-26, 1973 (AD-D106 657)
Key Words: Alloy 713C, IN-100, Udimet 700, sulfur addition, carbide phases, crack growth

29. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Regis, M. N., Flemings, M. C., Merton, C.
Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Semi-Annual Technical Report Number Three Jul-Dec 1971
Contract No : DAHC15-70-C-0283
130 pp., 1972 (AD-739 340)
Key Words: IN-100, MAR-M509, Maraging 300, microstructure, tensile properties, fatigue, hardness, creep rupture, fracture toughness

IN-738

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by Heat Treatment and Hot Isostatic Pressing Techniques**
   Baldan, A.
   J Mater Sci 26 (13), 3409-21, 1991
   Key Words: IN-100, Nimonic 80A, Nimonic 115, Nimonic 75, Nimonic 105, Nimonic 90, IN-738, IN-738LC, Inconel X-750, turbine components, creep, grain size, cavitation

2. **Assessment of Service Induced Microstructural Damage and Its Rejuvenation in Turbine Blades**
   Koul, A. K., Castillo, R.
   Metall Trans 19a (8), 2049-66, 1988 (AD-D139 440)
   Key Words: IN-738LC, turbine components, microstructure, grain boundaries, fractography, degradation, service life, rejuvenation, creep properties

3. **Rejuvenation of Service-Exposed IN 738 Turbine Blades**
   Koul, A.K., Immarigeon, J-P, Castillo, R., Lowden, P., Liburdi, J.
   The Metallurgical Society of AIME, Warrendale, PA
   Proc 6th Int Symp Superalloys 1988 755-64, 1988 (AD-D142 328)
   Key Words: IN-738, turbine components, rejuvenation, service life, aluminide coatings, creep rupture

4. **The Effect of Service Exposure on the Creep Properties of Cast IN-738LC Subjected to Low Stress High Temperature Creep Conditions**
   Castillo, R., Koul, A.K., Immarigeon, J-P.A.
   The Metallurgical Society of AIME, Warrendale, PA
   Proc 6th Int Symp Superalloys 1988 805-14, 1988 (AD-D142 331)
   Key Words: IN-738LC, turbine components, grain boundaries, fracture, creep rupture, stress cracking

5. **Mechanical Properties of Conventionally Cast, Directionally Solidified, and Single-Crystal Superalloys**
   Quested, P. N., Osgerby, S.
   Mater Sci Technol 2 (5), 461-75, 1986 (AD-D140 385)
   Key Words: IN-935, IN-738, IN-939, IN-597, IN-738LC, MAR-M246, MAR-M002, MAR-M247, Alloy 713LC, unidirectional solidification, creep

6. **Creep Dominated Damage Processes**
   Hoffelner, W.
   Kluwer Academic Publishers, Norwell, MA
   Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1 413-39, 1986 (AD-D142 074)
   Key Words: Incoloy 800H, IN-738LC, IN-939, microstructure, creep, corrosive environment

7. **Fatigue Dominated Damage Processes**
   Bressers, J., Remy, L., Hoffelner, W.
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   Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1 441-68, 1986 (AD-D142 075)
   Key Words: MAR-M509, IN-738LC, Hastelloy X, Inconel 617, RA-333, A-286, Inconel 718, Incoloy 901, microstructure, cracking, granular fracture, fatigue

8. **Effect of Fabrication and Repair Procedures on the Performance of IN 738 LC and IN 939**
Esser, W., McLean, M., Schneider, K.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1
593-622, 1986 (AD-D142 076)
Key Words: IN-738LC,IN-939, turbine components, welding, gas tungsten arc welding, electron beam welding, creep rupture strength, hot corrosion, welding, tensile properties, fatigue

9. **The Behavior of NIM 105 and IN738 LC Under Creep and LCF Testing**
Persson, P-O., Persson, C., Burman, G., Lindblom, Y.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 2
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Key Words: Nimonic 105, IN-738LC, fatigue strain, creep

10. **Hot Isostatic Press**
Author Anon, Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

11. **Experience with Repair of Stationary Gas-Turbine Blades--View of a Turbine Manufacturer**
Schneider, K., Jahnke, B., Burgel, R., Ellner, J.
Mater Sci Technol 1 (8), 613-9, 1985 (AD-D133 816)
Key Words: IN-738LC, turbine components, repairs, brazing, welding, microstructure, microcracking, oxidation, silicide coatings, fatigue, creep rupture

12. **Refurbishing Procedures for Blades of Large Stationary Gas Turbines**
Keinenburg, K-H., Esser, W., Deblon, B.
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Key Words: IN-738LC, Nimonic 80A, Udimet 520, turbine components, repair technique, corrosion, erosion, fatigue, tensile properties, tungsten arc welding

13. **Creep Life Predictions in Nickel-based Superalloys**
Koul, A. K., Castillo, R., Willett, K.
Mater Sci Eng 66 (2), 213-26, 1984 (AD-D131 247)
Key Words: MAR-M200, IN-738LC, Inconel X-750, turbine components, deformation, grain size, long term tests, shear stress

14. **Effects of Trace Elements on Mechanical Properties of Superalloys**
McLean, M., Strang, A., Met Technol 11 (10), 454-64, 1984 (AD-D131 862)
Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain boundaries, porosity, creep rupture

15. **Problems and Possibilities for Life Extension in Gas Turbine Components**
Koul, A. K., Wallace, W., Thamburaj, R.
National Aeronautical Establishment, Structures and Materials Section
Proc Propulsion and Energetics 63rd (B) Specialists' Meeting on Engine Cyclic Durability by Analysis and Testing, Lisse, Netherlands
10-1 to 10-32, 1984 (AD-D132 383)
Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine components, damage tolerance, EDM, creep, machining

16. **The Influence of Materials Processing on the High Temperature Low Cycle Fatigue Properties of the Cast Alloy IN-738LC**
Burke, M. A., Beck, C. G., Jr., Crombie, E. A.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 63-71, 1984 (AD-D132 827)
Key Words: IN-738LC, microstructure, crack propagation, fatigue, unidirectional solidification

17. **Assessment of Damage Accumulation and Property Regeneration by Hot Isostatic Pressing and Heat Treatment of Laboratory-Tested and Service Exposed IN738LC**
McLean, M., Tipler, H. R.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 73-82, 1984 (AD-D132 828)
Key Words: IN-738LC, turbine components, microstructure, stress intensity

18. **Comparison of Property Regeneration Techniques and Life Prediction Procedures Applied to Laboratory Tested and Service Exposed Ni-Cr Alloys**
McLean, M., Peck, M. S.
Final Report
Rept No : NPL-DMA-A-91, 48 pp., 1984 (AD-D134 696)
Key Words: IN-738LC, turbine components, crystallography, creep, heat treatment, rupture

19. **Improvement of Material Properties of Ni-Base Alloy Investment Castings by Hot Isostatic Processing**
Tsuji, I., Kawai, H.
NTIS, PB84-113422, Springfield, VA
Technical Report
Rept No : MTB-159, 8 pp., 1983 (AD-D130 515)
Key Words: IN-738, IN-738LC, Udimet 500, Alloy 713C, turbine components, fatigue

20. **Rejuvenation of Used Turbine Blades by Hot Isostatic Pressing and Reheat Treatment**
Cheung, K. L., Leach, C. C., Willett, K. P., Koul, A. K.
Westinghouse Canada Ltd., Hamilton, Ontario, Canada
Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in Service of High Temperature Parts
10-1 to 10-6, 1982 (AD-D125 467)
Key Words: Inconel X-750, IN-738, Nimonic 115, Nimonic 105, Inconel 700, turbine components, microstructure, rejuvenation, creep

21. **HIP Processing--Potentials and Applications**
Van Der Vet, W. J.
Chromalloy American Co., Midwest City, OK
Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in Service of High Temperature Parts
11-1 to 11-16, 1982 (AD-D125 468)
Key Words: Inconel X-750, Udimet 500, RENE' 100, B-1900, Nimonic 105, IN-738, IN-782, turbine components, fatigue, thermal cycling, creep rupture

22. **Regeneration of the Creep Properties of a Cast Ni-Cr-Base Alloy**
Tipler, H. R.
National Physical Lab, Teddington, UK
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Key Words: IN-738LC, creep, tensile properties, rejuvenation

23. **High-Temperature Electron Beam Welding of the Nickel-Base Superalloy IN-738LC**
Jahnke, B.
Weld J 61 (11), 343s to 347s, 1982 (AD-D125 951)
Key Words: IN-738LC, turbine components, microstructure, hot cracking, tensile properties, fatigue

24. **Hipping is One Way to Check Porosity in Cast Components**
Irving, R. R.
Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

25. **Scope for Repair Welding Gas Turbine Blades**
Elsner, W.
Pract Metall 19 (4), 199-214, 1982 (AD-D126 799)
Key Words: IN-738LC, Nimonic 90, Nimonic 105, Udimet 520, turbine components, microstructure, tensile properties, welding

26. **Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Mrencecin, D. E., Schilling, W. F., Ostergren, W. J.
General Electric Co., Gas Turbine Division, Schenectady, NY
Technical Paper
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

27. **High Cycle Fatigue Properties of Cast Nickel Base Superalloys IN 738LC and IN 939**
Schneider, K., Gnirrs, G., McColvin, G.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 319-44, 1982 (AD-D133 996)
Key Words: IN-738C, IN-939, grain size, porosity, particle size, fatigue

28. **Mechanisms of High Cycle Fatigue of Cast Nickel Base Alloys**
Schneider, K., Gnirrs, G., Truck, B., Arnim, G. V.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 685-701, 1982 (AD-D134 014)
Key Words: IN-738LC, IN-939, grain refinement, crack initiation, fatigue life

29. **Hipping: A Good Way to Improve Properties**
Irving, R. R.
Iron Age 224 (6), 77-81, 1981 (AD-D120 406)
Key Words: JT-9D, MERL 76, 17-4PH, RENE' 120, IN-792, IN-738, turbine components, porosity

30. **Long Term Materials Test Program: Materials Evaluation--Improved Simulation Tests**
Brobst, R. P., McCarron, R. L., Beltran, A. M., Spriggs, D. R., Grzybowski, D. F.
General Electric Co., Energy Systems Programs Department, Schenectady, NY
Technical Report
Rept No : DE82-000649, 54 pp., 1981 (AD-D125 182)
Key Words: FSX-414, IN-738, GTD-111, turbine components, coatings, erosion, hot corrosion

31. **European Concerted Action COST 50--Materials for Gas Turbines UK17--An Investigation of the Creep Fracture Process in a Cast Ni-Cr Base Alloy, IN738LC**
Tipler, H. R., Peck, M. S.
NTIS, PB83-212787, Springfield, VA
Final Rept Round Two
Rept No : NPL-DMA-A-33, 118 pp., 1981 (AD-D128 455)
Key Words: IN-738LC, turbine components, cracking, porosity, creep rupture, tensile properties

32. **Heat Treatment of Hot Isostatically Processed IN-738 Investment Castings**
Beddoes, J. C., Wallace, W.
Metall 13 (2), 185-94, 1980 (AD-D118 440)
Key Words: IN-738, turbine components, creep rupture twinning, heat treatment

33. ***Cutting Metal Loss Tied to Near Net Shapes***
Harvey, R. E.
Iron Age 222 (42), 57-63, 1979 (AD-D116 853)
Key Words: RENE' 77, IN-738, IN-792, AA C355-T6, AA A356-T61, 142-T6, net shape forming, fatigue, tensile properties

34. **Hot Isostatic Processing of IN-738 Turbine Blades**
Van Drunen, G., Liburdi, J., Wallace, W., Terada, T.
Westinghouse Canada Ltd. Hamilton (Ontario) Turbine and Generator Div
Proc 47th Meeting of the AGARD Structures and Materials Panel, Advanced Fabrication Processes
Rept No : AGARD-CP-256, 13-1 to 13-12, 1979 (AD-D117 188)
Key Words: IN-738, turbine components, creep rupture, tensile properties, fatigue, Larsen-Miller curves, thermal cycling

35. **Damage Accumulation and Fracture in Creep of Nickel-Base Alloys**
Tipler, H. R., Lindblom, Y., Davidson, J. G.
Applied Sciences Publishers Ltd., London, UK
Proc Conf High Temperature Alloys for Gas Turbines 359-407, 1978 (AD-D116 350)
Key Words: IN-597, Nimonic 115, IN-738LC, Nimonic 80A, MAR-M200, Udimet 500, Udimet 710, Udimet 720, turbine components, microstructure, grain boundaries, cracking, creep properties, fatigue, thermal fatigue, cavitation corrosion

36. ***Quality of Castings of Superalloys***
Bachelet, E., Lesoult, G.
Applied Sciences Publishers Ltd., London, UK
High Temperature Alloys for Gas Turbines 665-99, 1978 (AD-D116 360)
Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

37. **High Cycle Fatigue of Nickel-Base Alloys-European Concerted Action-- Cost 50-Materials for Gas Turbines, Project UK8**
McColvin, G. M.
NTIS, N79-18022, Springfield, VA
Final Report
Rept No : N79-18022, T.R. 2977, 99 pp., 1977 (AD-D115 653)
Key Words: Incoloy 901, IN-738, Nimonic 90, Nimonic 115, Inconel 718, fatigue, tensile properties, creep rupture, grain size

38. **Premium Quality Castings**
Freeman Jr., W. R.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 406-17, 1976 (AD-D119 187L)
Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue

39. **Improved Properties in Castings by Hot Isostatic Pressing**
Glenn, G. M.
SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355 porosity, tensile properties, microstructure, creep rupture, density, fatigue

40. **Processing: The Rediscovered Dimension in High Temperature Alloys**
Semchyshen, M.
Standardization News 4 (4), 9-19, 1976 (AD-D110 676)
Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

41. **Materials and Processing Technology for Advanced Gas Turbines**
Hauser, H. A.
SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

42. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
Mueller, J. J.
Electric Power Research Inst, Palo Alto, CA
Phase One Survey Report
Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

43. **Study of Superalloys Produced via Powder Metallurgy**
Hellner, L., Johansson, H.
NTIS, N77-13210, Springfield, VA
Final Report
Rept No : N77-13210, 56 pp., 1975 (AD-D109 492)
Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking, microstructure, temperature effect, deformation, stress intensity, tensile properties

IN-792

1. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

2. **Polycrystalline Grain Controlled Castings for Rotating Compressor and Turbine Components**
Ewing, B. A., Green, K. A.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 33-42, 1984 (AD-D132 824)
Key Words: Microcast X, IN-792, MAR-M247, AF-95, turbine components, microstructure, tensile properties, creep rupture

3. **Hipping is One Way to Check Porosity in Cast Components**
Irving, R. R.
Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

4. **Hipping: A Good Way to Improve Properties**
Irving, R. R.
Iron Age 224 (6), 77-81, 1981 (AD-D120 406)
Key Words: JT-9D, MERL 76, 17-4PH, RENE' 120, IN-792, IN-738, turbine components, porosity

5. **Applications of Composite Gas Turbine Components**
Peterson, L. G., Hrencecin, D. E., Carreno, D. E., Beltran, A. M., Schilling, W. F.
General Electric Co., Gas Turbine Division, Schenectady, NY
Semi-Annual Technical Progress Rept-Phase I
Rept No : DE82-004710, 30 pp., 1981 (AD-D125 782)
Key Words: MAR-M200, Udimet 700, IN-792, turbine components, tensile properties, creep, fatigue, diffusion bonding, unidirectional solidification

6. **A Solid-to-Solid HIP Bond Pressing Concept for the Manufacturing of Dual-Property Turbine-Wheels for Small Gas Turbines**
Ewing, B. A.
ASM International, Metals Park, OH
Proc 4th Int Symp Superalloys, Superalloys 1980 169-78, 1980 (AD-D120 647)
Key Words: MAR-M246, IN-792, turbine components, net shape forming, diffusion bonding, dissimilar joining, tensile properties, thermal fatigue

7. **HIP'ing Various Precision Cast Engine Components in Nickel-Based Superalloys**
Lamberigts, M., Diderrich, E., Coutsouradis, D., de Lamotte, E., Drapier, J. M.
Proc 4th Int Symp Superalloys, Superalloys 1980 285-94, 1980 (AD-D120 658)
Key Words: Alloy 713LC, IN-792, MAR-M002, MAR-M004, IN-100, jet engines, turbine components, creep, microstructure

8. **Cutting Metal Loss Tied to Near Net Shapes**
Harvey, R. E.
Iron Age 222 (42), 57-63, 1979 (AD-D116 853)
Key Words: RENE' 77, IN-738, IN-792, AA C355-T6, AA A356-T61, 142-T6, net shape forming, fatigue, tensile properties

9. **HIP, the Great Healer of Castings**
Bittence, J. C.
Mater Eng 88 (4), 54-7, 1978 (AD-D113 844)
Key Words: Inconel 718, IN-792, Ti-6Al-4V, 17-4PH, AA A357, porosity, fatigue, creep properties, deformation, cost

10. **HIP'ing Raises Casting Performance Levels**
Freeman, W. R., Jr., Metal Prog 112 (3), 33-8, 1977 (AD-D110 513)
Key Words: B-1900, IN-792, Ti-6Al-4V, IN-100, tensile properties turbine components, fatigue, creep rupture

11. **Premium Quality Castings**
Freeman Jr., W. R.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 406-17, 1976 (AD-D119 187L)
Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue

12. **Materials and Processing Technology for Advanced Gas Turbines**
Hauser, H. A., SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

13. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
Mueller, J. J., Electric Power Research Inst, Palo Alto, CA
Phase One Survey Report
Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

IN-939

1. **Mechanical Properties of Conventionally Cast, Directionally Solidified, and Single-Crystal Superalloys**
Quested, P. N., Osgerby, S.
Mater Sci Technol 2 (5), 461-75, 1986 (AD-D140 385)
Key Words: IN-935, IN-738, IN-939, IN-597, IN-738LC, MAR-M246, MAR-M002, MAR-M247, Alloy 713LC, unidirectional solidification, creep

2. **Creep Dominated Damage Processes**
Hoffelner, W., Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1 413-39, 1986 (AD-D142 074)
Key Words: Incoloy 800H, IN-738LC, IN-939, microstructure, creep, corrosive environment

3. **Effect of Fabrication and Repair Procedures on the Performance of IN 738 LC and IN 939**
Esser, W., McLean, M., Schneider, K.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1 593-622, 1986 (AD-D142 076)
Key Words: IN-738LC,IN-939, turbine components, welding, gas tungsten arc welding, electron beam welding, creep rupture strength, hot corrosion, welding, tensile properties, fatigue

4. **Effects of Trace Elements on Mechanical Properties of Superalloys**
McLean, M., Strang, A., Met Technol 11 (10), 454-64, 1984 (AD-D131 862)
Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain boundaries, porosity, creep rupture

5. **Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Hrenceein, D. E., Schilling, W. F., Ostergren, W. J.
General Electric Co., Gas Turbine Division, Schenectady, NY
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

6. **High Cycle Fatigue Properties of Cast Nickel Base Superalloys IN 738LC and IN 939**
Schneider, K., Gnirrs, G., McColvin, G.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 319-44, 1982 (AD-D133 996)
Key Words: IN-738C, IN-939, grain size, porosity, particle size, fatigue

7. **Mechanisms of High Cycle Fatigue of Cast Nickel Base Alloys**
Schneider, K., Gnirrs, G., Truck, B., Arnim, G. V.
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Key Words: IN-738LC, IN-939, grain refinement, crack initiation, fatigue life

8. **Quality of Castings of Superalloys**
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High Temperature Alloys for Gas Turbines 665-99, 1978 (AD-D116 360)
Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

Incoloy 901

1. **Fatigue Dominated Damage Processes**
Bressers, J., Remy, L., Hoffelner, W.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1 441-68, 1986 (AD-D142 075)
Key Words: MAR-M509, IN-738LC, Hastelloy X, Inconel 617, RA-333, A-286, Inconel 718, Incoloy 901, microstructure, cracking, granular fracture, fatigue

2. **Problems and Possibilities for Life Extension in Gas Turbine Components**
Koul, A. K., Wallace, W., Thamburaj, R.
National Aeronautical Establishment, Structures and Materials Section
Proc Propulsion and Energetics 63rd (B) Specialists' Meeting on Engine Cyclic Durability by Analysis and Testing, Lisse, Netherlands
10-1 to 10-32, 1984 (AD-D132 383)
Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine components, damage tolerance, EDM, creep, machining

3. **Materials for Advanced Turbine Engine--MATE**
Evans, D. J., Sheffler, K. D., Friedrich, L. A.
Pratt and Whitney Aircraft Group, East Hartford, CT
Contract No : NAS 3-20072,1982, 21 pp. (AD-D125 191)
Key Words: Hastelloy X, Incoloy 901, MA956, Udimet 700, MERL 76, turbine components, combustors, erosion, coatings, oxide dispersion strengthening

4. **Materials for Advanced Turbine Engine-MATE**
Evans, D. J., Henricks, R. J., Friedrich, L. A.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Technical Progress Report Number Twenty, Dec 80-Feb 81
Contract No : NAS 3-20072, 48 pp., 1981 (AD-D120 953)
Key Words: MERL 76, MA956, Hastelloy X, Incoloy 901, aircraft structures, combustor liners, turbine components, tensile properties, creep, crack growth, coatings, thermal fatigue

5. **Aircraft Gas Turbine Materials and Processes**
Kear, B. H., Thompson, E. R.
Science 208 (4446), 847-56, 1980 (AD-D126 322)
Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

6. **High Cycle Fatigue of Nickel-Base Alloys-European Concerted Action-- Cost 50-Materials for Gas Turbines, Project UK8**
McColvin, G. M.
NTIS, N79-18022, Springfield, VA
Rept No : N79-18022, T.R. 2977, 99 pp., 1977 (AD-D115 653)
Key Words: Incoloy 901, IN-738, Nimonic 90, Nimonic 115, Inconel 718, fatigue, tensile properties, creep rupture, grain size

Inconel 625

1. **Cast 625 Hot Isostatic Pressing (HIP) Parameters - a Statistically Designed Study**
Carlson, R. G.
TMS, Warrendale, PA
Proc Int Symp Metall Appl Superalloys 718, 625 Var Deriv 97-106, 1991
Key Words: Inconel 625, tensile properties, computer model, defects

2. **Severe Sour Gas Service Performance of HIP-Clad Alloy 625**
Bednarowicz, T. A., Byrd, J. D., Raymond, E. L., Bunch, P. D.
Materials Performance 28 (1), 59-63, 1989 (AD-D140 727)
Key Words: Inconel 625, corrosive medium, sour gas wells

3. **Repair Techniques for Gas Turbine Components**
Liburdi, J.
Liburdi Engineering Ltd. Burlington, Ontario, Canada
Proc 61st Meeting of the AGARD Structures and Materials Panel, Advanced Joining of Aerospace Metallic Materials
Rept No : AGARD-CP-398, 22-1 to 22-12, 1985 (AD-D139 985)
Key Words: Inconel X-750, Inconel 625, Udimet 500, Inconel 700, diffusion brazing, vacuum deposition, tensile properties, creep rupture

4. **Progress of Powder Metallurgy in North America**
Roll, K.H., Johnson, P.K.
Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

Inconel 718

1. **The Effect of Laves Phase on the Mechanical Properties of Wrought and Cast + HIP Inconel 718**
Schirra, J. J., Caless, R. H., Hatala, R. W., TMS, Warrendale, PA
Proc Int Symp Metall Appl Superalloys 718, 625 Var Deriv 375-88, 1991
Key Words: Inconel 718, tensile properties, microstructure, fracture toughness, impact toughness, fatigue, cracking

2. **An Evaluation of the Effects of Filler Metal Composition on Cast Alloy 718 Simulated Repair Welds**
Kelly, T. J., Cremisio, W. H., Simon, W. H.
Weld J 68 (1), 14-s to 18-s, 1989 (AD-D140 251)
Key Words: Inconel 718, microstructure, HAZ, welding, fatigue

3. **Elemental Effects on Cast 718 Weldability**
Kelly, T. J., Weld J 68 (2), 44-s to 51-s, 1989 (AD-D140 721)
Key Words: Inconel 718, turbine components, microstructure, tensile properties, rupture strength, welding

4. **Near-Threshold Crack Growth in Nickel-Base Superalloys**
Van Stone, R. H., Krueger, D. D., ASTM, Philadelphia, PA
Proc Fracture Mechanics, Nineteenth Symp
Rept No : ASTM-STP-969, 883-906, 1988 (AD-D139 966)
Key Words: RENE' 95, Inconel 718, microstructure, grain size, fatigue crack growth, tensile properties

5. **Microstructure and Properties of Ni-Fe Base Ta-718**
Loewenkamp, S.A., Radavich, J.F., Kelly, T.
The Metallurgical Society of AIME, Warrendale, PA
Proc 6th Int Symp Superalloys 1988 53-62, 1988 (AD-D142 283)
Key Words: Inconel 718, microstructure, tensile properties creep rupture

6. **Effect of HIP Parameters on Fine Grain Cast Alloy 718**
Siereveld, P., Radavich, J.F., Kelly, T., Cole, G., Widmer, R.
The Metallurgical Society of AIME, Warrendale, PA
Proc 6th Int Symp Superalloys 1988 459-68, 1988 (AD-D142 309)
Key Words: Inconel 718, microscopy, grain growth, porosity, heat treating, tensile properties

7. **Effects of Thermal and Thermo-Mechanical Treatments on the Mechanical Properties of Centrifugally Cast Alloy 718**
Michel, D. J., Smith, H. H., Naval Research Lab, Washington DC
Rept No : NRL-MR-6101, 22 pp., 1987 (AD-A188 195)
Key Words: Inconel 718, fatigue, crack growth, creep rupture microstructure, crystallography, brittle fracture, aging, thermomechanical treatment, homogenizing

8. **The Role of Hot Isostatic Pressing--Now and in the Future**
Widmer, R.
ASM International, Metals Park, OH
Proc Nicholas J. Grant Symp, Processing and Properties of Advanced High Temperature Alloys
105-16, 1986 (AD-D139 357)
Key Words: Udimet 700, Inconel 718, densification, fatigue, creep rupture

9. **Fatigue Dominated Damage Processes**
Bressers, J., Remy, L., Hoffelner, W.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1
441-68, 1986 (AD-D142 075)
Key Words: MAR-M509, IN-738LC, Hastelloy X, Inconel 617, RA-333, A-286, Inconel 718, Incoloy 901, microstructure, cracking, granular fracture, fatigue

10. **Effects of Trace Elements on Mechanical Properties of Superalloys**
McLean, M., Strang, A.
Met Technol 11 (10), 454-64, 1984 (AD-D131 862)
Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain boundaries, porosity, creep rupture

11. **Fatigue Growth of Surface Cracks in Nickel-Based Superalloys**
Brown, C. W., Hicks, M. A.
Int J Fatigue 4 (2), 73-81, 1982 (AD-D124 743)
Key Words: Inconel X-750, Inconel 718, turbine components, microstructure, grain size, crack growth, fatigue, tensile properties

12. **Hot Isostatic Pressing of Alloy IN-718**
Lamberigts, M., Herman, C., Louis, P., Wallemacq, J. P., Drapier, J. M.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 999-1011, 1982 (AD-D134 030)
Key Words: Inconel 718, turbine components, welding, tensile properties, creep rupture

13. **Healing Defects by HIP**
Dreger, D. R.
Mach Des 53 (12), 79-85, 1981 (AD-D121 264)
Key Words: Inconel 718, porosity, welding, cracking, fatigue, creep, tensile properties

14. **Use of a d-c Potential Drop Crack Monitoring Technique in the Development of Defect Tolerant Disk Alloys**
Van Stone, R. H., Krueger, D. D., Duvelius, L. T.
ASTM, Philadelphia, PA
Proc 14th National Symp Fracture Mechanics 2, 553-78, 1981 (AD-D128 740)
Key Words: RENE' 95, Inconel 718, turbine components, microstructure, tensile properties, crack growth, fatigue,

15. **Process Optimization of Cast Alloy 718 for Water Cooled Gas Turbine Application**
Bouse, G. K., Schilke, P. W.
ASM International, Metals Park, OH
Proc 4th Int Symp Superalloys, Superalloys 1980 303-10, 1980 (AD-D120 660)
Key Words: Inconel 718, turbine components, dislocation structure, homogenizing, tensile properties

16. **New Method for Cast Superalloy Frames**
Schweikert, W., Bailey, P. G.
U.S. Army Mantech J 5 (3), 28-32, 1980 (AD-D126 145)
Key Words: Inconel 718, turbine components, fatigue, microstructure, welding, chemical milling

17. **Investigation of Rejuvenation of Fatigue Damage in IN-718**
Clauer, A. H., Leis, B. N., Hoover, G., Seifert, D. A.
Battelle Memorial Institute, Columbus, OH
Final Report
Rept No : AFML-TR-78-90, 115 pp., 1978 (AD-A068 333)
Key Words: IN-718, microstructure, rejuvenation, fatigue, tensile properties

18. **HIP, the Great Healer of Castings**
Bittence, J. C.
Mater Eng 88 (4), 54-7, 1978 (AD-D113 844)
Key Words: Inconel 718, IN-792, Ti-6Al-4V, 17-4PH, AA A357, porosity, fatigue, creep properties, deformation, cost

19. **Original HCl Surface Treatment for Diffusion Bonding of Nickel Superalloy Specimens**
Billard, D., Trottier, J. P.
Met Technol 5 (9), 309-19, 1978 (AD-D114 028)
Key Words: IN-100, Waspaloy, RENE' 95, Inconel 718, welding, grain size, bonding, recrystallization, temperature effect

20. **High Cycle Fatigue of Nickel-Base Alloys-European Concerted Action-- Cost 50-Materials for Gas Turbines, Project UK8**
McColvin, G. M.
NTIS, N79-18022, Springfield, VA
Final Report
Rept No : N79-18022, T.R. 2977, 99 pp., 1977 (AD-D115 653)
Key Words: Incoloy 901, IN-738, Nimonic 90, Nimonic 115, Inconel 718, fatigue, tensile properties, creep rupture, grain size

21. **Superalloy Casting Process**
Schweikert, W. H., Piwonka, T. S.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 93-116, 1976 (AD-D119 169L)
Key Words: Inconel 718, forging, turbine components, tensile properties, fatigue

22. **High Integrity Casting Program**
Schweikert, W. H.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 392-405, 1976 (AD-D119 186L)
Key Words: Inconel 718, Ti-6Al-4V, 17-4PH, AA A357, tensile properties, nondestructive testing

23. **Processing: The Rediscovered Dimension in High Temperature Alloys**
Semchyshen, M.
Standardization News 4 (4), 9-19, 1976 (AD-D110 676)
Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

24. **Precision Castings State-of-the-Art**
Nagan, R. M., SAMPE Qtrly 6 (4), 1-7, 1975 (AD-D102 565)
Key Words: 17-4PH, Hastelloy X, Inconel 718, Ti-6Al-4V, aircraft structures, turbine components, tensile properties

25. **Complex Rotor Fabrication by Hot Isostatic Pressure Welding**
Lessman, G. G., Bryant, W. A.
Weld J 51 (12), 606s-614s, 1972 (AD-180 534)
Key Words: AISI 4340, Inconel 718, hardness, tensile properties

Inconel X-750

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by Heat Treatment and Hot Isostatic Pressing Techniques**
Baldan, A., J Mater Sci 26 (13), 3409-21, 1991
Key Words: IN-100, Nimonic 80A, Nimonic 115, Nimonic 75, Nimonic 105, Nimonic 90, IN-738, IN-738LC, Inconel X-750, turbine components, creep, grain size, cavitation

2. **Repair Techniques for Gas Turbine Components**
Liburdi, J., Liburdi Engineering Ltd. Burlington, Ontario, Canada
Proc 61st Meeting of the AGARD Structures and Materials Panel, Advanced Joining of Aerospace Metallic Materials
Rept No : AGARD-CP-398, 22-1 to 22-12, 1985 (AD-D139 985)
Key Words: Inconel X-750, Inconel 625, Udimet 500, Inconel 700, diffusion brazing, vacuum deposition, tensile properties, creep rupture

3. **Creep Life Predictions in Nickel-based Superalloys**
Koul, A. K., Castillo, R., Willett, K.
Mater Sci Eng 66 (2), 213-26, 1984 (AD-D131 247)
Key Words: MAR-M200, IN-738LC, Inconel X-750, turbine components, deformation, grain size, long term tests, shear stress

4. **Effects of Trace Elements on Mechanical Properties of Superalloys**
McLean, M., Strang, A., Met Technol 11 (10), 454-64, 1984 (AD-D131 862)
Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain boundaries, porosity, creep rupture

5. **Problems and Possibilities for Life Extension in Gas Turbine Components**
Koul, A. K., Wallace, W., Thamburaj, R.
National Aeronautical Establishment, Structures and Materials Section
Proc Propulsion and Energetics 63rd (B) Specialists' Meeting on Engine Cyclic Durability by Analysis and Testing, Lisse, Netherlands
10-1 to 10-32, 1984 (AD-D132 383)
Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine components, damage tolerance, EDM, creep, machining

6. **Fatigue Growth of Surface Cracks in Nickel-Based Superalloys**
Brown, C. W., Hicks, M. A.
Int J Fatigue 4 (2), 73-81, 1982 (AD-D124 743)
Key Words: Inconel X-750, Inconel 718, turbine components, microstructure, grain size, crack growth, fatigue, tensile properties

7. **Rejuvenation of Used Turbine Blades by Hot Isostatic Pressing and Reheat Treatment**
Cheung, K. L., Leach, C. C., Willett, K. P., Koul, A. K.
Westinghouse Canada Ltd., Hamilton, Ontario, Canada
Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in Service of High Temperature Parts
10-1 to 10-6, 1982 (AD-D125 467)
Key Words: Inconel X-750, IN-738, Nimonic 115, Nimonic 105, Inconel 700, turbine components, microstructure, rejuvenation, creep

8. **HIP Processing--Potentials and Applications**
Van Der Vet, W. J.
Chromalloy American Co., Midwest City, OK
Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in Service of High Temperature Parts
11-1 to 11-16, 1982 (AD-D125 468)
Key Words: Inconel X-750, Udimet 500, RENE' 100, B-1900, Nimonic 105, IN-738, IN-782, turbine components, fatigue, thermal cycling, creep rupture

MAR-M002

1. **Mechanical Properties of Conventionally Cast, Directionally Solidified, and Single-Crystal Superalloys**
Quested, P. N., Osgerby, S.
Mater Sci Technol 2 (5), 461-75, 1986 (AD-D140 385)
Key Words: IN-935, IN-738, IN-939, IN-597, IN-738LC, MAR-M246, MAR-M002, MAR-M247, Alloy 713LC, unidirectional solidification, creep

2. **Effects of Trace Elements on Mechanical Properties of Superalloys**
McLean, M., Strang, A.
Met Technol 11 (10), 454-64, 1984 (AD-D131 862)
Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain boundaries, porosity, creep rupture

3. **Characterizations of Elevated Temperature Fatigue Crack Growth Rates**
Crompton, J. S., Morley, S. A., Martin, J. W.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 761-9, 1984 (AD-D132 885)
Key Words: MAR-M002, Nimonic AP1, unidirectional solidification, fatigue crack, stress relaxation

4. **The Effect of Hot Isostatic Pressing on the Creep and Fracture Behavior of the Cast Superalloy MAR-M002**
Burt, H., Dennison, J. P., Elliott, I. C., Wilshire, B.
Mater Sci Eng 53 (2), 245-50, 1982 (AD-D125 089)
Key Words: MAR-M002, microstructure, porosity, cracking, surface defects, fracture mechanics, creep, ductility

5. **HIP'ing Various Precision Cast Engine Components in Nickel-Based Superalloys**
Lamberigts, M., Diderrich, E., Coutsouradis, D., de Lamotte, E., Drapier, J. M.
Proc 4th Int Symp Superalloys, Superalloys 1980 285-94, 1980 (AD-D120 658)
Key Words: Alloy 713LC, IN-792, MAR-M002, MAR-M004, IN-100, jet engines, turbine components, creep, microstructure

6. **Casting Conditions, Microstructure and Creep Properties of MAR-M-002 Blades**
Viatour, P., Coutsouradis, D., Habraken, L., Drapier, J. M.
Applied Sciences Publishers Ltd., London, UK
Proc Conf High Temperature Alloys for Gas Turbines 875-91, 1978 (AD-D116 366)
Key Words: MAR-M002, turbine components, rotor blades, microstructure, porosity, grain boundaries, creep rupture, precipitation, segregation, thermomechanical treatment

MAR-M200

1. **Microstructural Damages Induced During the Repair Process**
Davin, A., Lecomte-Mertens, Ch., Vierset, P., Louis, P.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1
811-20, 1986 (AD-D142 085)
Key Words: Haynes 188, MAR-M200, X-40, turbine components, tensile properties, thermal shock, diffusion brazing, rejuvenation, repairs, welding

2. **Structural Damage and Rejuvenation of Used Turbine Blades**
Lamberigts, M., Lecomte-Mertens, Ch., Vierset, P.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1
821-30, 1986 (AD-D142 086)
Key Words: MAR-M200, turbine components, microstructure, aging, rupture strength, service life, rejuvenation

3. **Creep Life Predictions in Nickel-based Superalloys**
Koul, A. K., Castillo, R., Willett, K.
Mater Sci Eng 66 (2), 213-26, 1984 (AD-D131 247)
Key Words: MAR-M200, IN-738LC, Inconel X-750, turbine components, deformation, grain size, long term tests, shear stress

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General Electric Co., Gas Turbine Division, Schenectady, NY
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

5. **Superalloy Technology-Today and Tomorrow**
VerSnyder, F. L., Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 1-49, 1982 (AD-D133 988)
Key Words: MAR-M200, IN-100, Udimet 700, carbon addition, boron addition, zirconium addition, cobalt addition, turbine components, corrosion, oxidation, REP, creep rupture, thermal fatigue

6. **Precision Casting of Turbine Blades and Vanes**
Drapier, J. M., Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 887-908, 1982 (AD-D134 025)
Key Words: Alloy 713LC, IN-100, MAR-M200, PWA 1480, MAR-M247, CMSX2, turbine components, rejuvenation, oxidation, vacuum melting, unidirectional solidification

7. **Applications of Composite Gas Turbine Components**
Peterson, L. G., Hrencecin, D. E., Carreno, D. E., Beltran, A. M., Schilling, W. F.
General Electric Co., Gas Turbine Division, Schenectady, NY
Rept No : DE82-004710, 30 pp., 1981 (AD-D125 782)
Key Words: MAR-M200, Udimet 700, IN-792, turbine components, tensile properties, creep, fatigue, diffusion bonding, unidirectional solidification

8. **HIP Rejuvenation of Damaged Blades**
Stewart, D. C., Bennett, G. T.
Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
Interim Technical Report One and Two, Aug 77-Mar 79
Rept No : FR-11642, 115 pp., 1979 (AD-D108 398L)
Key Words: IN-100, MAR-M200, unidirectional solidification, creep properties, aluminides, PWA 73 coating, surface defects, rejuvenation

9. **The Promise of more Heat Resistant Turbine Materials**
Freche, J. C., Ault, G. M.
Prod Engineering 50 (7), 35-9, 1979 (AD-D115 942)
Key Words: AF 2-1DA, AF-115, NASA IIB-7, NASA IIB-11, MAR-M200, MA6000E, WAZ-D, WAZ20, IN-100, service life, creep rupture, tensile properties, coatings, corrosion, thermal fatigue, unidirectional solidification

10. **Damage Accumulation and Fracture in Creep of Nickel-Base Alloys**
Tipler, H. R., Lindblom, Y., Davidson, J. G.
Applied Sciences Publishers Ltd., London, UK
Proc Conf High Temperature Alloys for Gas Turbines 359-407, 1978 (AD-D116 350)
Key Words: IN-597, Nimonic 115, IN-738LC, Nimonic 80A, MAR-M200, Udimet 500, Udimet 710, Udimet 720, turbine components, microstructure, grain boundaries, cracking, creep properties, fatigue, thermal fatigue, cavitation corrosion

11. **Coatings for Directionally Solidified Gamma Prime-Gamma Plus Alpha Eutectics**
Smeggil, J.
United Technologies Research Center, East Hartford, CT
Rept No : R77-912959-1, 12 pp., 1977 (AD-D108 260)
Key Words: MAR-M200, hafnium addition, nickel aluminide coatings, CoCrAlY coatings, NiCoCrAlY coatings, platinum addition, thermal expansion, oxidation, sulfidation, unidirectional solidification

12. **Premium Quality Castings**
Freeman Jr., W. R.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 406-17, 1976 (AD-D119 187L)
Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue

13. **Cost/Benefit Analysis of Advanced Materials Technologies for Future Aircraft Turbine Engines**
Bisset, J. W.
United Technologies Corp., East Hartford, CT
Rept No : N77-14026, PWA-5453, 42 pp., 1976 (AD-D107 956)
Key Words: MAR-M509, Hastelloy X, Waspaloy, IN-100, MAR-M200, turbine components, single crystals, hafnium addition, unidirectional solidification, cost

14. **Materials and Processing Technology for Advanced Gas Turbines**
Hauser, H. A., SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

MAR-M246

1. **Advanced Single Crystal for SSME Turbopumps**
Fritzemeier, L. G., Rockwell International, Rocketdyne Div, Canoga Park, CA
Contract No : NAS3-24646, 8 pp., 1988 (AD-D138 556)
Key Words: MAR-M246, fatigue, creep rupture, tensile properties

2. **Mechanical Properties of Conventionally Cast, Directionally Solidified, and Single-Crystal Superalloys**
Quested, P. N., Osgerby, S.
Mater Sci Technol 2 (5), 461-75, 1986 (AD-D140 385)
Key Words: IN-935, IN-738, IN-939, IN-597, IN-738LC, MAR-M246, MAR-M002, MAR-M247, Alloy 713LC. unidirectional solidification, creep

3. **A Solid-to-Solid HIP Bond Pressing Concept for the Manufacturing of Dual-Property Turbine-Wheels for Small Gas Turbines**
Ewing, B. A., ASM International, Metals Park, OH
Proc 4th Int Symp Superalloys, Superalloys 1980 169-78, 1980 (AD-D120 647)
Key Words: MAR-M246, IN-792, turbine components, net shape forming, diffusion bonding, dissimilar joining, tensile properties, thermal fatigue

4. **The Metallurgical Aspects of Hot Isostatically Pressed Superalloy Castings**
Antony, K. C., Radavich, J. F.
Proc 4th Int Symp Superalloys, Superalloys 1980 257-65, 1980 (AD-D120 655)
Key Words: Alloy 713C, MAR-M246, microstructure, porosity, tensile properties, creep rupture, fatigue, fracture toughness

MAR-M247

1. **Manufacturing Processes for Long-Life Gas Turbines**
Hoppin, G. S., III, Danesi, W. P.
J Met 38 (7), 20-3, 1986 (AD-D136 463)
Key Words: MAR-M247, turbine components, diffusion bonding

2. **Metallurgical Advancements in Investment Casting Technology**
Dardi, L. E., Dalal, R. P., Yaker, C.
ASM International, Metals Park, OH
Proc Nicholas J. Grant Symp, Processing and Properties of Advanced High Temperature Alloys
25-39, 1986 (AD-D139 354)
Key Words: MAR-M247, Ni-7Al-14Mo, Ti-6Al-4V, turbine components, fatigue properties, unidirectional solidification

3. **Mechanical Properties of Conventionally Cast, Directionally Solidified, and Single-Crystal Superalloys**
Quested, P. N., Osgerby, S.
Mater Sci Technol 2 (5), 461-75, 1986 (AD-D140 385)
Key Words: IN-935, IN-738, IN-939, IN-597, IN-738LC, MAR-M246, MAR-M002, MAR-M247, Alloy 713LC, unidirectional solidification, creep

4. **Development of a Conventional Fine Grain Casting Process**
Woulds, M., Benson, H.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 3-12, 1984 (AD-D132 821)
Key Words: Alloy 713LC, MAR-M247, turbine components, microstructure, creep rupture, tensile properties, fatigue

5. **Polycrystalline Grain Controlled Castings for Rotating Compressor and Turbine Components**
Ewing, B. A., Green, K. A.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 33-42, 1984 (AD-D132 824)
Key Words: Microcast X, IN-792, MAR-M247, AF-95, turbine components, microstructure, tensile properties, creep rupture

6. **Properties of Cast MAR-M-247 for Turbine Blisk Applications**
Kaufman, M.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 43-52, 1984 (AD-D132 825)
Key Words: MAR-M247, turbine components, defects, crack growth, tensile properties, fatigue, threshold stress

7. **Precision Casting of Turbine Blades and Vanes**
Drapier, J. M.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 887-908, 1982 (AD-D134 025)
Key Words: Alloy 713LC, IN-100, MAR-M200, PWA 1480, MAR-M247, CMSX2, turbine components, rejuvenation, oxidation, vacuum melting, unidirectional solidification

MERL 76

1. **Development of Gatorized(R) MERL 76 for Gas Turbine Disk Applications**
Caless, R.H., Paulonis, D.F.
The Metallurgical Society of AIME, Warrendale, PA
Proc 6th Int Symp Superalloys 1988 101-10, 1988 (AD-D142 288)
Key Words: MERL 76, turbine components, grain size, crack growth, tensile properties, flow stress, gatorizing, fatigue

2. **On the Sintered Ni-Base Superalloy (VI)--Effect of Microstructures on the Creep Property**
Morishita, M., Nagai, H., Shoji, K.
J Jpn Soc Powder Powder Metall 33 (7), 373-8, 1986 (AD-D136 163)
Key Words: IN-100, MERL 76, microstructure, swaging, creep rate, liquid sintering, creep rupture

3. **Overview of Temperature and Environmental Effects on Fatigue of Structural Metals**
Coffin, L. F.
Plenum Press, New York, NY
Proc 27th Sagamore Army Materials Research Conf 1-40, 1983 (AD-D131 509)
Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76, IN-100, NASA IIB-7, crack growth, fatigue

4. **Materials for Advanced Turbine Engine--MATE**
Evans, D. J., Sheffler, K. D., Friedrich, L. A.
Pratt and Whitney Aircraft Group, East Hartford, CT
Mar-May 82
Contract No : NAS 3-20072
1982, 21 pp. (AD-D125 191)
Key Words: Hastelloy X, Incoloy 901, MA956, Udimet 700, MERL 76, turbine components, combustors, erosion, coatings, oxide dispersion strengthening

5. **The Relationship Between Structure, Properties, and Processing in Powder Metallurgy Superalloys**
Davidson, J. H., Aubin, C.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 853-86, 1982 (AD-D134 024)
Key Words: Udimet 700, Nimonic AP1, MERL 76, RENE' 95, turbine components, microstructure, crack propagation, fatigue, creep rupture, impact, thermomechanical treatment

6. **Hipping: A Good Way to Improve Properties**
Irving, R. R.
Iron Age 224 (6), 77-81, 1981 (AD-D120 406)
Key Words: JT-9D, MERL 76, 17-4PH, RENE' 120, IN-792, IN-738, turbine components, porosity

7. **Materials for Advanced Turbine Engine-MATE**
Evans, D. J., Henricks, R. J., Friedrich, L. A.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Technical Progress Report Number Twenty, Dec 80-Feb 81
Contract No : NAS 3-20072
48 pp., 1981 (AD-D120 953)
Key Words: MERL 76, MA956, Hastelloy X, Incoloy 901, aircraft structures, combustor liners, turbine components, tensile properties, creep, crack growth, coatings, thermal fatigue

Nimonic 90

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by Heat Treatment and Hot Isostatic Pressing Techniques**
Baldan, A.
J Mater Sci 26 (13), 3409-21, 1991
Key Words: IN-100, Nimonic 80A Nimonic 115, Nimonic 75, Nimonic 105, Nimonic 90, IN-738, IN-738LC, Inconel X-750, turbine components, creep, grain size, cavitation

2. **Repair and Regeneration of Turbine Blades, Vanes, and Discs**
Huff, H., Wortmann, J.
Motoren und Turbinen Union GMBH, Munich, Germany
Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in Service of High Temperature Parts
13-1 to 13-7, 1982 (AD-D125 470)
Key Words: IN-100, Nimonic 90, Nimonic 108, turbine components, welding, creep, rejuvenation

3. **Scope for Repair Welding Gas Turbine Blades**
Elsner, W.
Pract Metall 19 (4), 199-214, 1982 (AD-D126 799)
Key Words: IN-738LC, Nimonic 90, Nimonic 105, Udimet 520, turbine components, microstructure, tensile properties, welding

4. **High Cycle Fatigue of Nickel-Base Alloys-European Concerted Action-- Cost 50-Materials for Gas Turbines, Project UK8**
McColvin, G. M.
NTIS, N79-18022, Springfield, VA
Final Report
Rept No : N79-18022, T.R. 2977, 99 pp., 1977 (AD-D115 653)
Key Words: Incoloy 901, IN-738, Nimonic 90, Nimonic 115, Inconel 718, fatigue, tensile properties, creep rupture, grain size

Nimonic 105

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by Heat Treatment and Hot Isostatic Pressing Techniques**
Baidan, A.
J Mater Sci 26 (13), 3409-21, 1991
Key Words: IN-100, Nimonic 80A, Nimonic 115, Nimonic 75, Nimonic 105, Nimonic 90, IN-738, IN-738LC, Inconel X-750, turbine components, creep, grain size, cavitation

2. **The Behavior of NIM 105 and IN738 LC Under Creep and LCF Testing**
Persson, P-O., Persson, C., Burman, G., Lindblom, Y.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 2
1501-15, 1986 (AD-D142 159)
Key Words: Nimonic 105, IN-738LC, fatigue strain, creep

3. **Refurbishing Superalloy Components for Gas Turbines**
Lindblom, Y.
Mater Sci Technol 1 (8), 636-41 and 643, 1985 (AD-D133 819)
Key Words: Nimonic 105, turbine components, coatings, repairs, microstructure, rejuvenation, creep rate, fatigue

4. **Refurbishing Superalloy Components for Gas Turbines**
Lindblom, Y.
Mater Sci Technol 1 (8), 636-41, 1985 (AD-D319 428)
Key Words: Nimonic 105, turbine components, SEM, optical microscopy, blade life, creep

5. **Rejuvenation of Used Turbine Blades by Hot Isostatic Pressing and Reheat Treatment**
Cheung, K. L., Leach, C. C., Willett, K. P., Koul, A. K.
Westinghouse Canada Ltd., Hamilton, Ontario, Canada
Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in Service of High Temperature Parts, 10-1 to 10-6, 1982 (AD-D125 467)
Key Words: Inconel X-750, IN-738, Nimonic 115, Nimonic 105, Inconel 700, turbine components, microstructure, rejuvenation, creep

6. **HIP Processing--Potentials and Applications**
Van Der Vet, W. J., Chromalloy American Co., Midwest City, OK
Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in, Service of High Temperature Parts
11-1 to 11-16, 1982 (AD-D125 468)
Key Words: Inconel X-750, Udimet 500, RENE' 100, B-1900, Nimonic 105, IN-738, IN-782, turbine components, fatigue, thermal cycling, creep rupture

7. **Scope for Repair Welding Gas Turbine Blades**
Elsner, W., Pract Metall 19 (4), 199-214, 1982 (AD-D126 799)
Key Words: IN-738LC, Nimonic 90, Nimonic 105, Udimet 520, turbine components, microstructure, tensile properties, welding

8. **An Assessment of Hot Isostatic Pressing and Reheat Treatment for the Regeneration of Creep Properties of Superalloys**
Dennison, J. P., Elliot, I. C., Wilshire, B.
ASM International, Metals Park, OH
Proc 4th Int Symp Superalloys, Superalloys 1980 671-77, 1980 (AD-D120 696)
Key Words: Nimonic 105, IN-100, fracture mechanics, creep, heat treatment

Nimonic 115

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by Heat Treatment and Hot Isostatic Pressing Techniques**
Baldan, A., J Mater Sci 26 (13), 3409-21, 1991
Key Words: IN-100, Nimonic 80A, Nimonic 115, Nimonic 75, Nimonic 105, Nimonic 90, IN-738, IN-738LC, Inconel X-750, turbine components, creep, grain size, cavitation

2. **Rejuvenation of Used Turbine Blades by Hot Isostatic Pressing and Reheat Treatment**
Cheung, K. L., Leach, C. C., Willett, K. P., Koul, A. K.
Westinghouse Canada Ltd., Hamilton, Ontario, Canada
Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in Service of High Temperature Parts, 10-1 to 10-6, 1982 (AD-D125 467)
Key Words: Inconel X-750, IN-738, Nimonic 115, Nimonic 105, Inconel 700, turbine components, microstructure, rejuvenation, creep

3. **Damage Accumulation and Fracture in Creep of Nickel-Base Alloys**
Tipler, H. R., Lindblom, Y., Davidson, J. G.
Applied Sciences Publishers Ltd., London, UK
Proc Conf High Temperature Alloys for Gas Turbines 359-407, 1978 (AD-D116 350)
Key Words: IN-597, Nimonic 115, IN-738LC, Nimonic 80A, MAR-M200, Udimet 500, Udimet 710, Udimet 720, turbine components, microstructure, grain boundaries, cracking, creep properties, fatigue, thermal fatigue, cavitation corrosion

4. **High Cycle Fatigue of Nickel-Base Alloys-European Concerted Action-- Cost 50-Materials for Gas Turbines, Project UK8**
McColvin, G. M.
NTIS, N79-18022, Springfield, VA
Final Report
Rept No : N79-18022, T.R. 2977, 99 pp., 1977 (AD-D115 653)
Key Words: Incoloy 901, IN-738, Nimonic 90, Nimonic 115, Inconel 718, fatigue, tensile properties, creep rupture, grain size

PWA 1480

1. **The Role of the gamma/gamma prime Eutectic and Porosity on the Tensile Behavior of a Single-Crystal Nickel-Base Superalloy**
Walston, W. S., Bernstein, I. M., Thompson, A. W.
Metall Trans A 22A, 1443-51, 1991
Key Words: PWA 1480, tensile properties, porosity, fracture, single crystals

2. **Advanced Single Crystal for SSME Turbopumps**
Fritzemeier, L. G.
Rockwell International, Rocketdyne Div, Canoga Park, CA
Final Contractor Report
Rept No : RI/RD 88-273, N89-21072, 48 pp., 1989 (AD-D141 694)
Key Words: PWA 1480, space shuttle, turbine components, porosity, crack propagation, tensile properties, creep, rupture strength, fatigue

3. **The Influence of High Thermal Gradient Casting, Hot Isostatic Pressing and Alternate Heat Treatment on the Structure and Properties of a Single Crystal Nickel Base Superalloy**
Fritzemeier, L.G.
The Metallurgical Society of AIME, Warrendale, PA
Proc 6th Int Symp Superalloys 1988 265-74, 1988 (AD-D142 299)
Key Words: PWA 1480, space shuttle, porosity, creep rupture, tensile properties, fatigue, hydrogen environment

4. **Advanced Single Crystal for SSME Turbopumps**
Fritzemeier, L. G.
Rockwell International, Rocketdyne Div, Canoga Park, CA
Quarterly Technical Progress Report, Mar-Jun 87
Contract No : NAS3-24646
6 pp., 1987 (AD-D138 334)
Key Words: PWA 1480, defects, tensile properties, fatigue

5. **Mechanical Behavior and Processing of DS and Single Crystal Superalloys**
Khan, T., Caron, P., Nakagawa, Y. G.
J Met 38 (7), 16-9, 1986 (AD-D136 462)
Key Words: CMSX2, PWA 1480, Alloy 454, tensile properties, creep rupture, fatigue

6. **Precision Casting of Turbine Blades and Vanes**
Drapier, J. M.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 887-908, 1982 (AD-D134 025)
Key Words: Alloy 713LC, IN-100, MAR-M200, PWA 1480, MAR-M247, CMSX2, turbine components, rejuvenation, oxidation, vacuum melting, unidirectional solidification

Rene' 80

1. **High Pressure Turbine Blade Life Extension**
Smith, H. H., Michel, D. J.
Naval Research Lab, Washington DC
Final Memorandum Report
Rept No : NRL-MR-6861, 47 pp., 1991 (AD-A240 654)
Key Words: RENE' 80H, MERL 72, turbine components, tensile properties creep rupture, microstructure, welding

2. **Deformation Mechanisms of Thermostructural Materials**
Arsenault, R. J., Louat, N., Shahinian, P., Singh, A. K., Chaki, T.
Crystal Growth and Materials Testing Associates, Lanham, MD
Final Report
Rept No : 162, 46 pp., 1987 (AD-A184 070)
Key Words: IN-100, RENE' 80, turbine components, CoCrAl coatings, creep rupture, thermal fatigue, barrier coatings, dislocation

3. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

4. **A Mechanistically Based Model for High Temperature Notched LCF of RENE' 80**
Domas, P. A., Antolovich, S. D.
Eng Fract Mechanics 21 (1), 203-14, 1985 (AD-D131 953)
Key Words: RENE' 80, microstructure, heat treatment, fatigue, tensile properties

5. **Hipping is One Way to Check Porosity in Cast Components**
Irving, R. R.
Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

6. **Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
General Electric Co., Gas Turbine Division, Schenectady, NY
Technical Paper
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

7. **Turbine Blade Technology--Present and Future**
Allen, R. E., Sidenstick, J. E.
American Institute of Aeronautics and Astronautics, New York, NY
Proc Century 2 Aerospace Conf, American Society of Mechanical engineers, San Francisco, CA, Aug 1960
7 pp., 1981 (AD-D126 839)
Key Words: RENE' 80, RENE' 150, turbine components, aircraft structures, coatings, welding

8. **Premium Quality Castings**
Freeman Jr., W. R.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 406-17, 1976 (AD-D119 187L)
Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue

9. **Improved Properties in Castings by Hot Isostatic Pressing**
Glenn, G. M., SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355 porosity, tensile properties, microstructure, creep rupture, density, fatigue

10. **Processing: The Rediscovered Dimension in High Temperature Alloys**
Semchyshen, M.
Standardization News 4 (4), 9-19, 1976 (AD-D110 676)
Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

11. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
Mueller, J. J., Electric Power Research Inst, Palo Alto, CA
Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

Rene' 95

1. **Constraint-Loss Model for the Growth of Surface Fatigue Cracks**
Van Stone, R. H., Gilbert, M. S., Gooden, O. C., Laflen, J. H.
ASTM, Philadelphia, PA
Proc Fracture Mechanics, Nineteenth Symp
Rept No : ASTM-STP-969, 637-56, 1988 (AD-D139 960)
Key Words: RENE' 95, surface defects, fracture mechanics, fatigue crack growth

2. **Near-Threshold Crack Growth in Nickel-Base Superalloys**
Van Stone, R. H., Krueger, D. D.
ASTM, Philadelphia, PA
Proc Fracture Mechanics, Nineteenth Symp
Rept No : ASTM-STP-969, 883-906, 1988 (AD-D139 966)
Key Words: RENE' 95, Inconel 718, microstructure, grain size, fatigue crack growth, tensile properties

3. **Modelling of Deformation and Microstructural Changes in P/M RENE' 95 Under Isothermal Forging Conditions**
Alniak, O., Morphy, D. D., Terada, T., Koul, A. K., Immarigeon, J-P.
National Aeronautical Establishment, Ottawa, Canada
Proc 65th Meeting of the AGARD Structures and Materials Panel
2-1 to 2-18, 1987 (AD-D140 764)
Key Words: RENE' 95, microstructure, grain refinement, deformation, flow stress, compression tests

4. **Advanced Machining Research Program (AMRP). Volume 5. Economic Modeling**
Flom, D. G.
General Electric Corporate Research and Development, Schenectady, NY
Final Report Jul 79-Aug 83
Rept No : AFWAL-TR-84-4059-Vol-5, 230 pp., 1984 (AD-B088 346L)
Key Words: Ti-6Al-4V, RENE' 95, turbine components, gun tubes, laser machining

5. **Effects of Processing and Microstructure on the Fatigue Behavior of the Nickel-Base Superalloy RENE' 95**
Miner, R. V., Gayda, J.
Int J Fatigue 6 (3), 189-93, 1984 (AD-D130 746)
Key Words: RENE' 95, grain size, fatigue crack, tensile properties, aging

6. **Fatigue Crack Initiation and Propagation in Several Nickel-Base Superalloys at 650**
Gayda, J., Miner, R. V.
Int J Fatigue 5 (3), 135-43, 1983 (AD-D127 868)
Key Words: Waspaloy, IN-100, RENE' 95, turbine components, fatigue, creep-fatigue, crack growth, porosity, fracture mechanics, tensile properties, microstructure,

7. **Overview of Temperature and Environmental Effects on Fatigue of Structural Metals**
Coffin, L. F.
Plenum Press, New York, NY
Proc 27th Sagamore Army Materials Research Conf 1-40, 1983 (AD-D131 509)
Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76, IN-100, NASA IIB-7, crack growth, fatigue

8. **The Relationship Between Structure, Properties, and Processing in Powder Metallurgy Superalloys**
Davidson, J. H., Aubin, C.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 853-86, 1982 (AD-D134 024)
Key Words: Udimet 700, Nimonic AP1, MERL 76, RENE' 95, turbine components, microstructure, crack propagation, fatigue, creep rupture, impact, thermomechanical treatment

9. **Use of a d-c Potential Drop Crack Monitoring Technique in the Development of Defect Tolerant Disk Alloys**
Van Stone, R. H., Krueger, D. D., Duvelius, L. T.
ASTM, Philadelphia, PA
Proc 14th National Symp Fracture Mechanics 2, 553-78, 1981 (AD-D128 740)
Key Words: RENE' 95, Inconel 718, turbine components, microstructure, tensile properties, crack growth, fatigue,

10. **Review of Superalloy Powder Metallurgy Processing for Aircraft Gas Turbine Applications**
Bartos, J. L.
ASTM, Philadelphia, PA
Proc Symp MiCon 78, 564-77, 1979 (AD-D126 411)
Key Words: RENE' 95, turbine components, tensile properties, creep rupture, net shape forming

11. **Material for Advanced Turbine Engines-MATE**
Bamberger, E. N., Mosier, J. S., Harrison, R. W.
General Electric Co., Aircraft Engine Group, Evendale, OH
Eighth Quarterly Engineering Report One, Dec-Feb 78
Rept No : R78AEG265, 111 pp., 1978 (AD-D112 563)
Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, creep properties, crack growth, notch sensitivity, tensile properties, thermal properties, oxidation, corrosion, fatigue

12. **Materials for Advanced Turbine Engines-MATE**
Bamberger, E. N., Mosier, J. S., Harrison, R.W.
General Electric Co., Aircraft Engine Group, Evendale, OH
Ninth Quarterly Engineering Report, Mar-May 78
Rept No : R78AEG356, 20 pp., 1978 (AD-D113 124)
Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, coatings, microstructure, net shape forming

13. **Material for Advanced Turbine Engines-MATE**
Arnold, D. B., Mosier, J. S., Harrison, R. W.
General Electric Co., Aircraft Engine Group, Evendale, OH
Quarterly Engineering Report Number Ten, Jun-Aug 78
Rept No : R78AEG496, 56 pp., 1978 (AD-D113 898)
Key Words: RENE' 95, RENE' 150, turbine components, compressor components, unidirectional solidification, tensile properties, fatigue, creep rupture, coatings

14. **Original HCl Surface Treatment for Diffusion Bonding of Nickel Superalloy Specimens**
Billard, D., Trottier, J. P.
Met Technol 5 (9), 309-19, 1978 (AD-D114 028)
Key Words: IN-100, Waspaloy, RENE' 95, Inconel 718, welding, grain size, bonding, recrystallization, temperature effect

15. **Material for Advanced Turbine Engines-MATE**
Bamberger, E. N., Mosier, J. S.
General Electric Co., Aircraft Engine Group, Evendale, OH
Quarterly Engineering Report Number Six, Jun-Aug 77
Rept No : R77AEG529, 56 pp., 1977 (AD-D110 864)
Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, fatigue, creep rupture, tensile properties, fracture surface, temperature effect

16. **MATE-Materials for Advanced Turbine Engines**
Bamberger, E. N., Mosier, J. S., Harrison, R. W.
General Electric Co., Aircraft Engine Group, Evendale, OH
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Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, tensile properties, solution heat treatment

17. **Application of Hot Isostatic Pressing to Aircraft Gas Turbines**
Evans, D. J.
Plenum Press, New York, NY
Proc 6th AIRAPT Int High Pressure Conf 2, 656-63, 1977 (AD-D126 192)
Key Words: Udimet 700, RENE' 95, Ti-6Al-4V, turbine components, tensile properties, creep rupture, net shape forming

18. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
Mueller, J. J.
Electric Power Research Inst, Palo Alto, CA
Phase One Survey Report
Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

19. **Manufacturing Methods for the Production of Disc Shapes by Contour Rolling**
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Key Words: RENE' 95, Hastelloy X, AISI 304, AF 2-1DA, microstructure, hot rolling

Rene' 120

1. **Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
General Electric Co., Gas Turbine Division, Schenectady, NY
Technical Paper
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

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Price, P.E.
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Key Words: RENE' 120, Ti-6Al-4V, aerospace applications, mechanical properties

3. **Hipping: A Good Way to Improve Properties**
Irving, R. R.
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Key Words: JT-9D, MERL 76, 17-4PH, RENE' 120, IN-792, IN-738, turbine components, porosity

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Key Words: Ti-6Al-4V, RENE' 120, Ti-6Al-2Sn-4Zr-2Mo, microstructure, fatigue

5. **Improved Properties in Castings by Hot Isostatic Pressing**
Glenn, G. M.
SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355 porosity, tensile properties, microstructure, creep rupture, density, fatigue

Rene' 150

1. **Development of Hybrid Gas Turbine Bucket Technology**
   Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
   General Electric Co., Gas Turbine Division, Schenectady, NY
   Technical Paper
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   Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

2. **Turbine Blade Technology--Present and Future**
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3. **Material for Advanced Turbine Engines-MATE**
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   Bamberger, E. N., Mosier, J. S., Harrison, R.W.
   General Electric Co., Aircraft Engine Group, Evendale, OH
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   Rept No : R78AEG356, 20 pp., 1978 (AD-D113 124)
   Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, coatings, microstructure, net shape forming

5. **Material for Advanced Turbine Engines-MATE**
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6. **Material for Advanced Turbine Engines-MATE**
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   General Electric Co., Aircraft Engine Group, Evendale, OH
   Quarterly Engineering Report Number Six, Jun-Aug 77
   Rept No : R77AEG529, 56 pp., 1977 (AD-D110 864)
   Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, fatigue, creep rupture, tensile properties, fracture surface, temperature effect

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General Electric Co., Aircraft Engine Group, Evendale, OH
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8. **HIP of Near-Net Shapes**
Dulis, E. J., Fleck, J. N.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 369-82, 1976 (AD-D119 184L)
Key Words: PA 101, Ti-6Al-4V, net shape forming, forging

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1. **Repair Techniques for Gas Turbine Components**
Liburdi, J.
Liburdi Engineering Ltd. Burlington, Ontario, Canada
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Rept No : AGARD-CP-398, 22-1 to 22-12, 1985 (AD-D139 985)
Key Words: Inconel X-750, Inconel 625, Udimet 500, Inconel 700, diffusion brazing, vacuum deposition, tensile properties, creep rupture

2. **Improvement of Material Properties of Ni-Base Alloy Investment Castings by Hot Isostatic Processing**
Tsuji, I., Kawai, H.
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Rept No : MTB-159, 8 pp., 1983 (AD-D130 515)
Key Words: IN-738, IN-738LC, Udimet 500, Alloy 713C, turbine components, fatigue

3. **HIP Processing--Potentials and Applications**
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Chromalloy American Co., Midwest City, OK
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4. **Damage Accumulation and Fracture in Creep of Nickel-Base Alloys**
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Applied Sciences Publishers Ltd., London, UK
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Key Words: IN-597, Nimonic 115, IN-738LC, Nimonic 80A, MAR-M200, Udimet 500, Udimet 710, Udimet 720, turbine components, microstructure, grain boundaries, cracking, creep properties, fatigue, thermal fatigue, cavitation corrosion

5. **Quality of Castings of Superalloys**
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Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

Udimet 700

1. **A Microanalytical Study of the Early Stages of Recrystallization in the Nickel-Base Superalloy APK1**
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Key Words: APK-1, microstructure, recrystallization

2. **Growth of Small Cracks in Aeroengine Disc Materials**
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Key Words: Udimet 700, Waspaloy, turbine components, fatigue, crack growth kinetics, tensile properties, temperature effect, microstructure, grain size, crack closure

3. **Influence of Cyclic to Mean Load Ratio on Creep/Fatigue Crack Growth**
Dimopulos, V., Nikbin, K. M., Webster, G. A.
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Key Words: Nimonic AP1, oxidation, plastic deformation, fracture, creep-fatigue

4. **The Effect of Temperature on Fatigue Crack Initiation from Aluminosilicate Inclusions**
Woollin, P., Knott, J. F.
Ecole Nationale Superieure des Mines de Paris, France
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Key Words: Nimonic AP1, fatigue crack, bend test, tensile properties

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Choe, S. J., Stoloff, N. S., Duquette, D. J.
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Widmer, R.
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Key Words: Udimet 700, Inconel 718, densification, fatigue, creep rupture

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Key Words: Nimonic AP1, fracture mechanics, creep-fatigue

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Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
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Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

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Zaplatynsky, I.
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Key Words: Udimet 700, cobalt addition, aluminide coatings, microstructure, crack growth

10. **Particle Surfaces and Prior Particle Boundaries in Hf Modified PM Astroloy**
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Key Words: Udimet 700, hafnium addition, microstructure, grain boundary segregation, tensile properties

11. **Problems and Possibilities for Life Extension in Gas Turbine Components**
Koul, A. K., Wallace, W., Thamburaj, R.
National Aeronautical Establishment, Structures and Materials Section
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Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine components, damage tolerance, EDM, creep, machining

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Key Words: MAR-M002, Nimonic AP1, unidirectional solidification, fatigue crack, stress relaxation

13. **Overview of Temperature and Environmental Effects on Fatigue of Structural Metals**
Coffin, L. F.
Plenum Press, New York, NY
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Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76, IN-100, NASA IIB-7, crack growth, fatigue

14. **Materials for Advanced Turbine Engine--MATE**
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Key Words: Hastelloy X, Incoloy 901, MA956, Udimet 700, MERL 76, turbine components, combustors, erosion, coatings, oxide dispersion strengthening

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Irving, R. R.
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Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile propeities, fatigue

16. **Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
General Electric Co., Gas Turbine Division, Schenectady, NY
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

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VerSnyder, F. L.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 1-49, 1982 (AD-D133 988)
Key Words: MAR-M200, IN-100, Udimet 700, carbon addition, boron addition, zirconium addition, cobalt addition, turbine components, corrosion, oxidation, REP, creep rupture thermal fatigue

18. **The Relationship Between Structure, Properties, and Processing in Powder Metallurgy Superalloys**
Davidson, J. H., Aubin, C.
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Proc Conf High Temperature Alloys for Gas Turbines 853-86, 1982 (AD-D134 024)
Key Words: Udimet 700, Nimonic AP1, MERL 76, RENE' 95, turbine components, microstructure, crack propagation, fatigue, creep rupture, impact, thermomechanical treatment

19. **Creep-Fatigue Environment Interactions in Superalloys**
Pelloux, R. M.
Massachusetts Institute of Technology, Department of Materials Science and Engineering, Cambridge, MA
Rept No : AFOSR-TR-81-0450, 35 pp., 1981 (AD-A098 790)
Key Words: Udimet 700, Waspaloy, IN-100, microstructure, creep, fatigue, embrittlement

20. **Applications of Composite Gas Turbine Components**
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Harvey, R. E.
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Key Words: RENE' 77, IN-738, IN-792, AA C355-T6, AA A356-T61, 142-T6, net shape forming, fatigue, tensile properties

22. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
Herman, H.
State University of New York at Stony Brook, Department of Materials Sciences, NY
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Key Words: Ti-6Al-4V, HY-130, AISI 304, Udimet 700, creep-fatigue, crack detection

23. **Application of Hot Isostatic Pressing to Aircraft Gas Turbines**
Evans, D. J.
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Key Words: Udimet 700, RENE' 95, Ti-6Al-4V, turbine components, tensile properties, creep rupture, net shape forming

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Widmer, R.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
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Key Words: Udimet 700, net shape forming, tensile properties, creep rupture, fatigue

25. **Improved Properties in Castings by Hot Isostatic Pressing**
Glenn, G. M.
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Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355 porosity, tensile properties, microstructure, creep rupture, density, fatigue

26. **Processing: The Rediscovered Dimension in High Temperature Alloys**
Semchyshen, M.
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Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

27. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
Mueller, J. J.
Electric Power Research Inst, Palo Alto, CA
Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

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Wallace, W., Holt, R. T., Terada, T.
Metall 6 (6), 511-26, 1973 (AD-D106 657)
Key Words: Alloy 713C, IN-100, Udimet 700, sulfur addition, carbide phases, crack growth

Waspaloy

1. **Growth of Small Cracks in Aeroengine Disc Materials**
Hudak, S. J., Jr., Davidson, D. L., Chan, K. S.
Southwest Research Institute, San Antonio, TX
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Key Words: Udimet 700, Waspaloy, turbine components, fatigue, crack growth kinetics, tensile properties, temperature effect, microstructure, grain size, crack closure

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Gayda, J., Miner, R. V.
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Key Words: Waspaloy, IN-100, RENE' 95, turbine components, fatigue, creep-fatigue, crack growth, porosity, fracture mechanics, tensile properties, microstructure,

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Coffin, L. F.
Plenum Press, New York, NY
Proc 27th Sagamore Army Materials Research Conf 1-40, 1983 (AD-D131 509)
Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76, IN-100, NASA IIB-7, crack growth, fatigue

4. **Creep-Fatigue Environment Interactions in Superalloys**
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Key Words: Udimet 700, Waspaloy, IN-100, microstructure, creep, fatigue, embrittlement

5. **All Systems Are Go for Powder Metallurgy**
Irving, R. R.
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Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

6. **Aircraft Gas Turbine Materials and Processes**
Kear, B. H., Thompson, E. R.
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Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

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Sundberg, D. V., Comey, D. H.
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Key Words: Ti-6Al-4V, Waspaloy, turbine components, rejuvenation, tensile properties

8. **Original HCl Surface Treatment for Diffusion Bonding of Nickel Superalloy Specimens**
Billard, D., Trottier, J. P.
Met Technol 5 (9), 309-19, 1978 (AD-D114 028)
Key Words: IN-100, Waspaloy, RENE' 95, Inconel 718, welding, grain size, bonding, recrystallization, temperature effect

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Bisset, J. W.
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Project Completion Report
Rept No : N77-14026, PWA-5453, 42 pp., 1976 (AD-D107 956)
Key Words: MAR-M509, Hastelloy X, Waspaloy, IN-100, MAR-M200, turbine components, single crystals, hafnium addition, unidirectional solidification, cost

10. **Processing: The Rediscovered Dimension in High Temperature Alloys**
Semchyshen, M.
Standardization News 4 (4), 9-19, 1976 (AD-D110 676)
Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

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Key Words: RENE' 80H, MERL 72, turbine components, tensile properties creep rupture, microstructure, welding

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Key Words: MA6000, turbine components, oxide dispersion, diffusion, strengthening, welding, creep rupture, tensile properties

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Key Words: ZhS6-K, microstructure, microprobe, reduction in area, atomization, creep rupture

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Key Words: Udimet 720, turbine components, crack growth, fracture surface, fatigue

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Dardi, L. E., Dalal, R. P., Yaker, C.
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Key Words: MAR-M247, Ni-7Al-14Mo, Ti-6Al-4V, turbine components, fatigue properties, unidirectional solidification

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Key Words: MAR-M509, IN-738LC, Hastelloy X, Inconel 617, RA-333, A-286, Inconel 718, Incoloy 901, microstructure, cracking, granular fracture, fatigue

13. **Refurbishing Procedures for Blades of Large Stationary Gas Turbines**
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Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine components, damage tolerance, EDM, creep, machining

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Ewing, B. A., Green, K. A.
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Key Words: Alloy 713LC, IN-100, MAR-M200, PWA 1480, MAR-M247, CMSX2, turbine components, rejuvenation, oxidation, vacuum melting, unidirectional solidification

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Key Words: Ni-12Cr-11Al-5Co-3Ta-1W, microstructure, porosity, gamma prime, anisotropy, single crystals, dislocation structure, hardening, fatigue, heat treatment

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Kidwell, J. R., Sundberg, D. V., Fujii, M.
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Key Words: Alloy 713LC, IN-792, MAR-M002, MAR-M004, IN-100, jet engines, turbine components, creep, microstructure

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Kear, B. H., Thompson, E. R.
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Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

35. **The Promise of more Heat Resistant Turbine Materials**
Freche, J. C., Ault, G. M.
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Key Words: AF 2-1DA, AF-115, NASA IIB-7, NASA IIB-11, MAR-M200, MA6000E, WAZ-D, WAZ20, IN-100, service life, creep rupture, tensile properties, coatings, corrosion, thermal fatigue, unidirectional solidification

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Applied Sciences Publishers Ltd., London, UK
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Key Words: IN-597, Nimonic 115, IN-738LC, Nimonic 80A, MAR-M200, Udimet 500, Udimet 710, Udimet 720, turbine components, microstructure, grain boundaries, cracking, creep properties, fatigue, thermal fatigue, cavitation corrosion

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Applied Sciences Publishers Ltd., London, UK
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Key Words: MA956E, CAPIVAC IV, Pyromet CTX-1, Haynes 556, Haynes 8077, MA754E, MA757E, turbine components, zirconium coatings, tensile properties, creep rupture, thermal processing, thermal fatigue, oxidation, gamma prime, oxide dispersion strengthening

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General Electric Co., Aircraft Engine Group, Evendale, OH
Interim Engineering Progress Report Number Five, Apr-Jun 72
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Key Words: RENE' 95, Hastelloy X, AISI 304, AF 2-1DA, microstructure, hot rolling

TITANIUM AND TITANIUM ALLOYS

Titanium

1. **Large Structural Titanium Castings**
   Barice, W. J.
   J Aircr 19 (8), 687-91, 1982 (AD-D125 528)
   Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components

2. **A Retrospective View of Metallurgy During the 25 Years of the Gillett Lectures**
   Jaffee, R. I.
   Standardization News 5 (1), 9-22, 1977 (AD-D108 834)
   Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement, fracture mechanics

3. **Flight Qualification of Titanium F-14a Airframe Components Manufactured by Hot Isostatic Pressing**
   Witt, R., Magnuson, J.
   Grumman Aerospace Corp., Bethpage, NY
   122 pp., 1977 (AD-D305 114)
   Key Words: titanium, specifications, ultrasonic testing, microporosity

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   Vaughan, R. F., Blenkinsop, P. A., Morton, P. H.
   Imperial Metal Industries (Kynoch) Ltd., Birmingham, UK MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
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   Key Words: Ti-6Al-4V, tensile properties, fracture toughness, fracture surface, titanium, CM steels, superalloys, surface layers, morphology, composition surface

Ti-6Al-2Sn-4Zr-2Mo

1. **Production of Large Titanium Investment Castings**
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   Key Words: Ti-6Al-2Sn-4Zr-2Mo, skull melting, chemical milling

2. **Developments in Titanium Alloy Casting Technology**
   Eylon, D., Froes, F. H., Gardiner, R. W.
   J Met 35 (2), 35-47, 1983 (AD-D126 785)
   Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth

3. **Large Structural Titanium Castings**
Barice, W. J.
J Aircr 19 (8), 687-91, 1982 (AD-D125 528)
Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components

4. **Cast Titanium Components for Rotating Gas Turbine Applications**
Ewing, B. A.
General Motors Corp., Detroit Diesel Allison Division
Proc 54th Meeting of the AGARD Structures and Materials Panel
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Key Words: Ti-6Al-4V, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Transage 175, turbine components, net shape forming, Charpy impact, tensile properties, fatigue, cost

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Price, P.
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Key Words: Ti-6Al-4V, RENE' 120, Ti-6Al-2Sn-4Zr-2Mo, microstructure, fatigue

6. **Materials and Processing Technology for Advanced Gas Turbines**
Hauser, H. A.
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Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

Ti-6Al-2Sn-4Zr-6Mo

1. **Developments in Titanium Alloy Casting Technology**
Eylon, D., Froes, F. H., Gardiner, R. W.
J Met 35 (2), 35-47, 1983 (AD-D126 785)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth

2. **Large Structural Titanium Castings**
Barice, W. J.
J Aircr 19 (8), 687-91, 1982 (AD-D125 528)
Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components

3. **Cast Titanium Components for Rotating Gas Turbine Applications**
Ewing, B. A.
General Motors Corp., Detroit Diesel Allison Division
Proc 54th Meeting of the AGARD Structures and Materials Panel
13-1 to 13-14, 1982 (AD-D127 041)
Key Words: Ti-6Al-4V, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Transage 175, turbine components, net shape forming, Charpy impact, tensile properties, fatigue, cost

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Irving, R. R.
Iron Age 223 (28), 41-5, 1980 (AD-D118 875)
Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

5. **Materials and Processing Technology for Advanced Gas Turbines**
Hauser, H. A.
SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

Ti-6Al-4V

1. **Effects of Treatments on Mechanical Properties of Titanium Alloy Castings**
Eylon, D., Froes, F. H., Barice, W. J.
SAMPE Qtrly 20 (2), 42-5, 1989 (AD-D140 690)
Key Words: Ti-6Al-4V, microstructure, tensile properties, fatigue, net shape

2. **Titanium NNS Technology Shaping Up**
Kubel, E. J., Jr.
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Key Words: Ti-6Al-4V, turbine components, near net shape, rapid solidification

3. **The Mechanical Properties of Superplastically Formed Titanium and Aluminum Alloys**
Partridge, P. G., McDarmaid, D. S., Bottomley, I., Common, D.
Royal Aircraft Establishment Farnborough, UK
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Key Words: Ti-6Al-4V, AA 7475, Supral 100, Supral 150, Supral 220, alclad coatings, microstructure, grain size, aging, elastic properties, fatigue, fracture toughness

4. **Titanium Near Net Shape Components for Demanding Airframe Applications**
Witt, R. H., Ferreri, A. L.
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Key Words: Ti-6Al-4V, Transage 175, Transage 134, fracture toughness, tensile properties

5. **Microstructure Modification of Ti-6Al-4V castings**
Eylon, D., Barice, W. J., Froes, F. H.
SAMPE J 22 (1), 24-9, 47, 1986 (AD-D136 432)
Key Words: Ti-6Al-4V, microstructure, tensile properties, fatigue, solution heat treatment

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Key Words: Ti-6Al-4V, turbine components, crack growth, forging, fatigue

7. **Metallurgical Advancements in Investment Casting Technology**
Dardi, L. E., Dalal, R. P., Yaker, C.
ASM International, Metals Park, OH
Proc Nicholas J. Grant Symp, Processing and Properties of Advanced High Temperature Alloys
25-39, 1986 (AD-D139 354)
Key Words: MAR-M247, Ni-7Al-14Mo, Ti-6Al-4V, turbine components, fatigue properties, unidirectional solidification

8. **Cast HIP and Heat Treated Titanium UH-60A Main Rotor Damper Bracket**
Kopchick, J. P., Silverstein, S. M.
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Rept No : USAAVSCOM-TR-85-F-4, 49 pp., 1985 (AD-B097 223)
Key Words: Ti-6Al-4V, UH-60A Black Hawk, casting, arc melting, fatigue, tensile properties

9. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

10. **Comparison of Various Fabrication Methods for the Production of an Aircraft Structural Component from Titanium Semifabricates (II)**
Mietrach, D., Blomeier, K.
Aluminum English 61 (3), E151-5, 1985 (AD-D131 961)
Key Words: Ti-6Al-4V, aircraft structures, tensile properties, hammer forging, electron beam welding

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Mietrach, D., Blomeier, K.
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Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, forging, extrusion, fatigue, tensile properties

12. **Effect of Hot Isostatic Pressing and Heat Treatment on Fatigue Properties of Ti-6Al-4V Castings**
Eylon, D., Froes, F. H., Levin, L.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
1, 179-86, 1985 (AD-D135 659)
Key Words: Ti-6Al-4V, microstructure, crack growth, fatigue stress, tensile properties

13. **Nontraditional Thermal Processing of HIP'ed Investment Cast Ti-6Al-4V Alloy**
Soltesz, S. M., Smickley, R. J., Dardi, L. E.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
1, 187-94, 1985 (AD-D135 660)
Key Words: Ti-6Al-4V, microstructure, tensile properties, fracture toughness, vacuum arc melting

14. **Fatigue Resistance Improvement of Ti-6Al-4V by Thermomechanical Treatment**
Levin, L., Vogt, R. G., Eylon, D., Froes, F. H.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
4, 2107-14, 1985 (AD-D136 775)
Key Words: Ti-6Al-4V, tensile properties, fatigue stress, hydrogenation

15. **Advanced Machining Research Program (AMRP). Volume 5. Economic Modeling**
Flom, D. G.
General Electric Corporate Research and Development, Schenectady, NY
Rept No : AFWAL-TR-84-4059-Vol-5, 230 pp., 1984 (AD-B088 346L)
Key Words: Ti-6Al-4V, RENE' 95, turbine components, gun tubes, laser machining

16. **Ti-6Al-4V Alloy Castings Prepared in Zircon Sand Molds and the Effect of Hot Isostatic Pressing**
Paige, J. I., Clites, P. G., Henry, J. L.
Bureau of Mines, Albany Research Center, Albany, NY
Rept No : BM-RI-8897, 20 pp., 1984 (AD-D134 349)
Key Words: Ti-6Al-4V, microstructure, tensile properties, fatigue stress, Charpy impact, sand casting

17. **Thermo-Chemical Treatment (TCT) of Titanium Alloy Net Shapes**
Vogt, R. G., Froes, F. H., Eylon, D., Levin, L.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Titanium--Net Shape Technologies 145-53, 1984 (AD-D134 599)
Key Words: Ti-6Al-4V, REP, tensile strength, fatigue stress, net shape forming

18. **Titanium Casting--A Review**
Eylon, D., Froes, F. H.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Titanium--Net Shape Technologies 155-77, 1984 (AD-D134 600)
Key Words: Ti-6Al-4V, repair welding, microstructure, fatigue crack

19. **Investment Casting of Large Components**
Barice, W. J.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Titanium--Net Shape Technologies 179-91, 1984 (AD-D134 601)
Key Words: Ti-6Al-4V, tensile properties, heat treatment

20. **The Thermal Processing Response of HIP'ed Investment Cast Ti-6Al-4V Alloy**
Smickley, R. J., Dardi, L. E.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Titanium--Net Shape Technologies 201-9, 1984 (AD-D134 603)
Key Words: Ti-6Al-4V, microstructure, fatigue, Charpy impact, tensile properties

21. **Status of Titanium Net-Shape Technology**
Vogt, R. G., Eylon, D., Froes, F. H., ASTM, Philadelphia, PA
Proc Symp Reactive and Refractory Metals and Alloys, Industrial Applications of Titanium and Zirconium., 4, 194-208, 1984 (AD-D141 674)
Key Words: Ti-6Al-4V, isothermal forging, net shape, tensile properties, fracture toughness

22. **Developments in Titanium Alloy Casting Technology**
Eylon, D., Froes, F. H., Gardiner, R. W.
J Met 35 (2), 35-47, 1983 (AD-D126 785)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth

23. **Porous Castings? HIPping Might be Your Answer**
Widmer, R., Price, P. E.
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Key Words: Ti-6Al-4V, stainless steel, aluminum alloys, porosity, rejuvenation, cost

24. **Large Structural Titanium Castings**
Barice, W. J.
J Aircr 19 (8), 687-91, 1982 (AD-D125 528)
Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components

25. **High Cycle Fatigue of Weld Repaired Cast Ti-6Al-4V**
Hunter, G. B., Hodi, F. S., Eagar, T. W.
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Key Words: Ti-6Al-4V, welding, crack growth, tensile properties, hardness, fatigue

26. **Recent Advancement in Titanium Near-Net Shape Technology**
Chen, C. C.
J Met 34 (11), 30-5, 1982 (AD-D126 098)
Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, net shape forming, cost

27. **Cast Titanium Components for Rotating Gas Turbine Applications**
Ewing, B. A.
General Motors Corp., Detroit Diesel Allison Division
Proc 54th Meeting of the AGARD Structures and Materials Panel
13-1 to 13-14, 1982 (AD-D127 041)
Key Words: Ti-6Al-4V, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Transage 175, turbine components, net shape forming, Charpy impact, tensile properties, fatigue, cost

28. **Fatigue Evaluation of the Molded T.A6V Alloy Isostatically Compacted Under Heat. Summary of Test #M9 505600**
Author Anon
NTIS, N84-27876, Springfield, VA
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Rept No : N84-27876, 65 pp., 1982 (AD-D131 694)
Key Words: Ti-6Al-4V, fatigue, molding, mechanical properties

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Author Anon
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Key Words: Ti-6Al-4V, microstructure, densification, fatigue

30. **Hot Isostatic Pressing in the Aerospace Industry**
Price, P.E.
Metal Prog 121 (2), 46-7, 1982 (AD-D200 345)
Key Words: RENE' 120, Ti-6Al-4V, aerospace applications, mechanical properties

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Hammer, A. N.
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Key Words: Ti-6Al-4V, turbine components, fatigue, welding, tensile properties, notch strength, stress corrosion

32. **Manufacture of Cost-Affordable High Performance Titanium Components for Advanced Air Force Systems**
Eylon, D., Field, M., Froes, F. H., Eichelman, G. E.
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Key Words: Ti-6Al-4V, tensile properties, fatigue, net shape forming, superplastic forming

33. **Mechanical Properties of Titanium Castings**
Ulitchny, M. G.
Bendix Corp., Kansas, MO
Rept No : BDX-613-2680. 11 pp., 1981 (AD-D124 358)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, fracture toughness, aging, tensile properties

34. **Energy Efficient Engine. Volume 2. Appendix A: Component Development and Integration Program**
Moracz, D. J., Cook, C. R.
TRW Inc., Materials Technology, Cleveland, OH
Final Technical Report Nov 78-Jun 81
Rept No : NASA-CR-173085, 200 pp., 1981 (AD-D134 362)
Key Words: Ti-6Al-[illegible], IN-100, seam welding, microstructure, diffusion bonding

35. **Synthesis of Microstructures and the Relationship Between Microstructure and Properties**
Rosenblum, M. E., Eylon, D.
Cincinnati University, Department of Materials Science and Metallurgical Engineering, Cincinnati, OH
Rept No : AFWAL-TR-80-4035, 41 pp., 1980 (AD-A089 602)
Key Words: Ti-6Al-4V, microstructure, fatigue, creep

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Irving, R. R.
Iron Age 223 (28), 41-5, 1980 (AD-D118 875)
Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

37. **Titanium Powder Metallurgy--A Perspective**
Kelto, C. A., Kosmal, B. A., Eylon, D., Froes, F. H.
J Met 32 (8), 17-25, 1980 (AD-D119 351)
Key Words: Ti-6Al-4V, fatigue, net shape forming, diffusion bonding

38. **Creep Behavior of Cast Ti-6Al-4V Alloy**
Chakrabarti, A. K., Nichols, E. S.
Metallurgical Society of AIME, Warrendale, PA
Proc 4th Int Conf Titanium, Titanium'80-Science and Technology
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Key Words: Ti-6Al-4V, grain size, creep, tensile properties, plastic deformation

39. **Influence of Manufacturing Method and Surface Condition on the Fatigue Strength of Ti-6Al-4V Material**
Broichhausen, J., Telfah, M.
Metallurgical Society of AIME, Warrendale, PA
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3, 1797-1806, 1980 (AD-D121 214)
Key Words: Ti-6Al-4V, fatigue, surface roughness, microhardness

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Marty, M., Octor H., Renon, C., Walder, A.
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-0542-79, 37 pp., 1979 (AD-B044 328L)
Key Words: Ti-6Al-4V, electron beam melting, hydriding, densification, hot extrusion, mechanical properties

41. **Manufacturing Methods for Low Cost Non-Rotating Titanium Engine Components**
Kemphaus, J. B.
General Electric Co., Aircraft Engine Group, Evendale, OH
Final Report Dec 74-Jun 79
Rept No : AFML-TR-79-4129, 143 pp., 1979 (AD-B045 094L)
Key Words: Ti-6Al-4V, diffusion bonding, creep, near net shape forming, notch properties, tensile properties, fatigue

42. **Use Properties for the Cast Alloy Titanium TA6V Whether Densified or Not by Hot Isostatic Compaction. Analysis of Tests Carried Out by the C.E.A.T. Between 1972 and 1978**
Deviller, I. P. A., Herteman, I. A.
Foreign Technology Division, Wright-Patterson AFB, OH
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Key Words: Ti-6Al-4V, defects, impact toughness, fatigue, bearings

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Paez, C.
Grumman Aerospace Corp., Bethpage, NY
Quarterly Progress Report Number Five, Oct 78-Jan 79
Contract No : F33615-77-C-3109
90 pp., 1979 (AD-D108 342L)
Key Words: Ti-6Al-4V, diffusion bonding, tensile properties, welding, compression tests, fatigue

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Sundberg, D. V., Comey, D. H.
Airesearch Mfg. Co. of Arizona, Phoenix, AZ
Final Technical Report
Rept No : 21-3238, 139 pp., 1979 (AD-A078 593)
Key Words: Ti-6Al-4V, Waspaloy, turbine components, rejuvenation, tensile properties

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Price, P.
Ind Heat 46 (6), 8-10, 1979 (AD-D115 742)
Key Words: Ti-6Al-4V, RENE' 120, Ti-6Al-2Sn-4Zr-2Mo, microstructure, fatigue

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Eylon, D.
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Key Words: Ti-6Al-4V, microstructure, grain boundaries, fractography, fatigue, crack growth

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Quarterly Progress Report Number Two, Jan-Apr 78
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Peebles, R. E.
General Electric Co., Aircraft Engine Group, Evendale, OH
Rept No : AFML-IR-189-7T(4), 59 pp., 1978 (AD-D114 365L)
Key Words: Ti-6Al-4V, Ti-5Al-2Sn-2Zr-4Cr-4Mo, isothermal process, forging, hydriding

49. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
Herman, H.
State University of New York at Stony Brook, Department of Materials Sciences, NY
Final Report
Contract No : N00014-78-M-0074
58 pp., 1978 (AD-A061 867)
Key Words: Ti-6Al-4V, HY-130, AISI 304, Udimet 700, creep-fatigue, crack detection

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Bittence, J. C.
Mater Eng 88 (4), 54-7, 1978 (AD-D113 844)
Key Words: Inconel 718, IN-792, Ti-6Al-4V, 17-4PH, AA A357, porosity, fatigue, creep properties, deformation, cost

51. **Casting High-Performance, High-Integrity Components**
Heine, H. J.
Foundry Manage Technol 105 (3), 88-96, 1977 (AD-D108 804)
Key Words: Ti-6Al-4V, 18/8 stainless, 18Cr-10Ni, AA A360, B1914, B1925, B1964, B1981, airframes, aircraft structures, creep rupture, stress analysis, nondestructive testing, tensile properties, tribaloy

52. **A Retrospective View of Metallurgy During the 25 Years of the Gillett Lectures**
Jaffee, R. I.
Standardization News 5 (1), 9-22, 1977 (AD-D108 834)
Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement, fracture mechanics

53. **Repair of Titanium Airframe Castings by Hot Isostatic Pressing**
Magnuson, J.
Metall 10 (2), 223-32, 1977 (AD-D109 428)
Key Words: Ti-6Al-4V, porosity, microstructure, defects, voids, metallography

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Freeman, W. R., Jr.
Metal Prog 112 (3), 33-8, 1977 (AD-D110 513)
Key Words: B-1900, IN-792, Ti-6Al-4V, IN-100, tensile properties turbine components, fatigue, creep rupture

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Evans, D. J.
Plenum Press, New York, NY
Proc 6th AIRAPT Int High Pressure Conf 2, 656-63, 1977 (AD-D126 192)
Key Words: Udimet 700, RENE' 95, Ti-6Al-4V, turbine components, tensile properties, creep rupture, net shape forming

56. **HCF Crack Initiation Analysis of Ti-6Al-4V Cast and HIP Specimens**
Eylon, D.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 73-87, 1976 (AD-D119 168L)
Key Words: Ti-6Al-4V, fracture surface, crack propagation, microstructure, fatigue stress, grain boundaries

57. **HIP of Near-Net Shapes**
Dulis, E. J., Fleck, J. N.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 369-82, 1976 (AD-D119 184L)
Key Words: PA 101, Ti-6Al-4V, net shape forming, forging

58. **High Integrity Casting Program**
Schweikert, W. H.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 392-405, 1976 (AD-D119 186L)
Key Words: Inconel 718, Ti-6Al-4V, 17-4PH, AA A357, tensile properties, nondestructive testing

59. **Improved Properties in Castings by Hot Isostatic Pressing**
Glenn, G. M.
SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355 porosity, tensile properties, microstructure, creep rupture, density, fatigue

60. **Comparative Evaluation of Forged Ti-6Al-4V Bar made from Shot Produced by the REP and CSC Processes**
Vaughan, R. F., Blenkinsop, P. A., Morton, P. H.
Imperial Metal Industries (Kynoch) Ltd., Birmingham, UK MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
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Key Words: Ti-6Al-4V, tensile properties, fracture toughness, fracture surface, titanium, CM steels, superalloys, surface layers, morphology, composition surface

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Hauser, H. A.
SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

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Nagan, R. M.
SAMPE Qtrly 6 (4), 1-7, 1975 (AD-D102 565)
Key Words: 17-4PH, Hastelloy X, Inconel 718, Ti-6Al-4V, aircraft structures, turbine components, tensile properties

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Mueller, J. J.
Electric Power Research Inst, Palo Alto, CA
Phase One Survey Report
Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

64. **Manufacturing of Titanium Airframe Components**
Witt, R., Magnuson, J.
Grumman Aerospace Corp., Bethpage, NY
Final Report, Apr 74-Apr 75
Contract No : N00019-74-C-0301
90 pp., 1975 (AD-D301 610)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, net shape, fracture toughness

65. **Titanium Powder Metallurgy**
Sutcliffe, P. W., Mardon, P. G.
AGARD Structures and Materials Panel, 17 pp., 1974 (AD-D102 697)
Key Words: Ti-6Al-4V, tensile properties, density, cost

Ti-6Al-6V-2Sn

1. **Comparison of Various Fabrication Methods for the Production of an Aircraft Structural Component from Titanium Semifabricates (I)**
Mietrach, D., Blomeier, K.
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Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, forging, extrusion, fatigue, tensile properties

2. **Developments in Titanium Alloy Casting Technology**
Eylon, D., Froes, F. H., Gardiner, R. W.
J Met 35 (2), 35-47, 1983 (AD-D126 785)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth

3. **Mechanical Properties of Titanium Castings**
Ulitchny, M. G., Bendix Corp., Kansas, MO
Rept No : BDX-613-2680, 11 pp., 1981 (AD-D124 358)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, fracture toughness, aging, tensile properties

4. **Engineering Design, Development, Fabrication and Testing Services Related to 155-mm, XM785 Nuclear Projectile**
Steiner, E. G., Ballheim, R. W., Brinker, G. G.
Chamberlain Mfg. Corp., Research and Development Division, Waterloo, IA
Rept No : C8182-PR-026, 452 pp., 1980 (AD-B052 420L)
Key Words: Ti-6Al-6V-2Sn, projectiles, ballistic tests, spin test

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Witt, R., Magnuson, J.
Grumman Aerospace Corp., Bethpage, NY
Final Report, Apr 74-Apr 75
Contract No : N00019-74-C-0301, 90 pp., 1975 (AD-D301 610)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, net shape, fracture toughness

Transage 175

1. **Titanium Near Net Shape Components for Demanding Airframe Applications**
Witt, R. H., Ferreri, A. L.
SAMPE Qtrly 17 (3), 55-62, 1986 (AD-D135 849)
Key Words: Ti-6Al-4V, Transage 175, Transage 134, fracture toughness, tensile properties

2. **Data Sheet: Transage 175 (Ti-2.7Al-13V-7Sn-2Zr) High-Strength Cast Alloy**
Crossley, F. A.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Beta Titanium Alloys in the 1980's 493-6, 1984 (AD-D136 674)
Key Words: Transage 175, thermal stability, density, tensile properties

3. **Cast Transage 175 Titanium Alloy for Durability Critical Structural Components**
Crossley, F. A., Barice, W. J.
J Aircr 20 (1), 66-9, 1983 (AD-D126 651)
Key Words: Transage 175, tensile properties, notch sensitivity, fatigue

4. **Developments in Titanium Alloy Casting Technology**
Eylon, D., Froes, F. H., Gardiner, R. W.
J Met 35 (2), 35-47, 1983 (AD-D126 785)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth

5. **Large Structural Titanium Castings**
Barice, W. J.
J Aircr 19 (8), 687-91, 1982 (AD-D125 528)
Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components

6. **Cast Titanium Components for Rotating Gas Turbine Applications**
Ewing, B. A., General Motors Corp., Detroit Diesel Allison Division
Proc 54th Meeting of the AGARD Structures and Materials Panel
13-1 to 13-14, 1982 (AD-D127 041)
Key Words: Ti-6Al-4V, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Transage 175, turbine components, net shape forming, Charpy impact, tensile properties, fatigue, cost

7. **Influence of Hot Isostatic Processing and Heat Treatment Variables on the Tensile Properties of Cast Transage 175 Alloy, Ti-2.5Al-13V-7Sn-2Zr**
Crossley, F. A., Barice, W. J., SAMPE, Azusa, CA
Proc 27th National SAMPE Symp and Exhibition 667-78, 1982 (AD-D127 142)
Key Words: Transage 175, Ti-2.5Al-13V-7Sn-2Zr, heat treatment, age hardening, tensile properties

8. **Mechanical Properties of Two Cast and Hot Isostatically Processed Martensitic Transage Titanium Alloys**
Crossley, F. A., Barice, W. J.
J Met 33 (2), 26-32, 1981 (AD-D120 560)
Key Words: Transage 129, Ti-2Al-11V-2Sn-11Zr, Transage 134, Transage 175, tensile properties, fatigue, density

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McKenzie, R.M.
Adv Mater Processes 136 (1), 45-6, 1989 (AD-D143 200)
Key Words: Ti-15V-3Cr-3Al-3Sn, cyclic aging, tensile properties

2. **Alloy Development, Processing and Characterization of Devitrified Titanium Base Microcrystalline Alloys**
Whang, Sung H.
Barnett Institute of Chemical Analysis and Materials Science, Northeastern University, Boston, MA
Annual Report,Contract No : N00014-82-K-0579, 17 pp., 1986 (AD-A172 140)
Key Words: titanium alloys, aluminum addition, tin addition yttrium addition, lanthanum addition, thorium addition, erbium addition, microscopy, age hardening, melt spinning, tensile properties

3. **Deformation of Rapidly Solidified Ti-2Er**
Kampe, S. L., Koss, D. A.
Department of Materials Science and Engineering, Pennsylvania State University, University Park, PA
Technical Report Number Three
Contract No : N00014-86-K-0381, 8 pp., 1986 (AD-A173 734)
Key Words: Ti-2Er, grain size, strain rate, flow stress, vacuum annealing

4. **Structure-Property Relationships in Centrifugally Cast IMI 550**
Kearns, M. W., Ward-Close, C. M.
SAMPE J 22 (1), 7-11, 1986 (AD-D134 747)
Key Words: IMI 550, tensile properties, fracture toughness, creep, aging

5. **Titanium Near Net Shape Components for Demanding Airframe Applications**
Witt, R. H., Ferreri, A. L.
SAMPE Qtrly 17 (3), 55-62, 1986 (AD-D135 849)
Key Words: Ti-6Al-4V, Transage 175, Transage 134, fracture toughness, tensile properties

6. **Manufacturing Process for the Hot Isostatic Pressing of Large Titanium PM (Powder Metallurgy) Shapes**
Petersen, V. C., Chandhok, V. K., Moll, J. H.
Colt Industries Inc., Crucible Materials Research Center, Pit' burgh, PA
Rept No : AFWAL-TR-85-4120, 474 pp., 1985 (AD-B101 439L)
Key Words: titanium alloys, crack propagation, fracture, weldability, toughness, machinability

7. **Titanium Mill Production**
Belov, A. F.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
1, 31-8, 1985 (AD-D135 651)
Key Words: VT5L, tensile properties, fatigue, heat treatment

8. **Alloy Development, Processing and Characterization of Devitrified Titanium Based Microcrystalline Alloys**
Whang, S. H.
Barnett Institute of Chemical Analysis and Materials Science, Northeastern University, Boston, MA
Annual Report, Contract No : N00014-82-K-0597, 113 pp.,1984 (AD-A149 609)
Key Words: Ti-5Sn-3Y, Ti-5Sn-4.5La, Ti-8Mo-2.5Al-1.5B, Ti-6Al-4V-2Si, Ti-2.5Al-5.5Er, Ti-5Al-2Si, Ti-18Zr-4.5Si, Ti(5)Si(3), Al(3)La, Ti-5Al-2.5Sn-3Ce, Ti-5Al-2.5Sn-1B, Ti-5Al-2.5Sn-2Y, Ti-5Al-2.5Sn, Ti-6.5Si, Ti-5Al-4Zr-2.5Sn-3La, Ti-8Zr-3.5Al-3.5Si, rapid solidification, hardness, rare earth solubility

9. **Emerging Trends in Aerospace Materials and Processes**
Chandler, H. E.
Metal Prog 125 (5), 21-9, 1984 (AD-D130 023)
Key Words: Ti-10V-2Fe-3Al, Ti-15V-3Cr-3Al-3Sn, steel, aircraft, net shape forming, manufacturing

10. **Thermal Treatment of Titanium Alloy TA6Zr5D Obtained by Powder Metallurgy**
Quesne, C., Severac, C., Servant, C.
NTIS, PB86-159415, Springfield, VA
Technical Translation
Rept No : PB86-159415, 55 pp., 1984 (AD-D140 123)
Key Words: IMI 685, microstructure, porosity, precipitation, tensile properties

11. **Developments in Titanium Alloy Casting Technology**
Eylon, D., Froes, F. H., Gardiner, R. W.
J Met 35 (2), 35-47, 1983 (AD-D126 785)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth

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NTIS, N84-23555, Springfield, VA
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Key Words: AA A357, titanium alloys, fracture mechanics, diffusion bonding, fatigue

13. **Treatment Processes of Light and Heat Resistant Alloys**
Belov, A. F., Tselikov, A. I., Trishkin, V. G., Rakovskiy, V. S., Rykalin, N. N.
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-0412-82, 335 pp., 1982 (AD-B070 680L)
Key Words: aluminum alloys, titanium alloys, mechanical properties, fatigue, cracking

14. **Large Structural Titanium Castings**
Barice, W. J.
J Aircr 19 (8), 687-91, 1982 (AD-D125 528)
Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components

15. **Recent Advancement in Titanium Near-Net Shape Technology**
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J Met 34 (11), 30-5, 1982 (AD-D126 098)
Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, net shape forming, cost

16. **Cast Titanium Components for Rotating Gas Turbine Applications**
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General Motors Corp., Detroit Diesel Allison Division
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17. **Influence of Hot Isostatic Processing and Heat Treatment Variables on the Tensile Properties of Cast Transage 175 Alloy, Ti-2.5Al-13V-7Sn-2Zr**
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SAMPE, Azusa, CA
Proc 27th National SAMPE Symp and Exhibition 667-78, 1982 (AD-D127 142)
Key Words: Transage 175, Ti-2.5Al-13V-7Sn-2Zr, heat treatment, age hardening, tensile properties

18. **Mechanical Properties of Two Cast and Hot Isostatically Processed Martensitic Transage Titanium Alloys**
Crossley, F. A., Barice, W. J., J Met 33 (2), 26-32, 1981 (AD-D120 560)
Key Words: Transage 129, Ti-2Al-11V-2Sn-11Zr, Transage 134, Transage 175, tensile properties, fatigue, density

19. **Advanced Manufacturing Methods for High Quality Low Cost Titanium Powder Production**
Peebles, R. E.
General Electric Co., Aircraft Engine Group, Evendale, OH
Rept No : AFML-IR-189-7T(4), 59 pp., 1978 (AD-D114 365L)
Key Words: Ti-6Al-4V, Ti-5Al-2Sn-2Zr-4Cr-4Mo, isothermal process, forging, hydriding

20. Research to Conduct an Exploratory Experimental and Analytical Investigation of Alloys
Ruckle, D. L., Blackburn, M. J., Hayden, S. Z.
Pratt and Whitney Aircraft Group, East Hartford, CT
Fourth Quarterly Report Nov 75-Feb 76
Rept No : EII-75-200-4001-3, 46 pp., 1976 (AD-D108 056L)
Key Words: Ti-16Al-10Nb, TiAl, turbine components, fatigue, bend test, ECG, EDM, creep, Charpy impact, creep rupture, notch properties, tensile properties

21. Materials and Processing Technology for Advanced Gas Turbines
Hauser, H. A.
SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

INTERMETALLIC COMPOUNDS

TiAl

1. **Flow Softening and Microstructure Evolution during Hot Working of Wrought Near-Gamma Titanium Aluminides**
   Semiatin, S. L., Frey, N., El-Soudani, S. M., Bryant, J. D.
   Metall Trans A 23A, 1719-35, 1992
   Key Words: TiAl, Ti-48 at pct Al-2.5 at pct Nb, Ti-48 at pct Al-2 at pct Nb-2 at pct Cr, isothermal forging, hot compression test

2. **Design, Manufacture, and Evaluation of Titanium Aluminide Components**
   O'Connell, T. E., Blackburn, M. J., Smith, M. P.
   Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
   Interim Report Feb-Apr 84
   Rept No : FR-18287, 45 pp., 1984 (AD-D130 536L)
   Key Words: TiAl, turbine components, extrusion, ring rolling, tensile properties, solution heat treatment

3. **R&D on Composition and Processing of Titanium Aluminide Alloys for Turbine Engines**
   Blackburn, M. J., Smith, M. P.
   Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
   Rept No : PWA-FR-16259, 103 pp., 1982 (AD-B069 620)
   Key Words: TiAl, Ti(3)Al, Ti-25Al-10Nb-3V-1Mo, Ti-48 at pct Al-1 at pct V, turbine components, aluminides, microstructure, modulus, tensile properties, creep rupture, Charpy impact, fatigue, fracture toughness, thermal properties

4. **Research to Conduct an Exploratory Experimental and Analytical Investigation of Alloys**
   Ruckle, D. L., Blackburn, M. J., Hayden, S. Z.
   Pratt and Whitney Aircraft Group, East Hartford, CT
   Rept No : EII-75-200-4001-3, 46 pp., 1976 (AD-D108 056L)
   Key Words: Ti-16Al-10Nb, TiAl, turbine components, fatigue, bend test, ECG, EDM, creep, Charpy impact, creep rupture, notch properties, tensile properties

5. **Materials and Processing Technology for Advanced Gas Turbines**
   Hauser, H. A., SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
   Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

Miscellaneous Intermetallic Compounds

1. **Flow Softening and Microstructure Evolution during Hot Working of Wrought TNear-Gamma Titanium Aluminides**
   Semiatin, S. L., Frey, N., El-Soudani, S. M., Bryant, J. D.
   Metall Trans A 23A, 1719-35, 1992
   Key Words: TiAl, Ti-48 at pct Al-2.5 at pct Nb, Ti-48 at pct Al-2 at pct Nb-2 at pct Cr, isothermal forging, hot compression test

2. **Mechanical Properties of Fe-Modified L1(2)-Type Al3Ti**
Inoue, H. R. P., Cooper, C. V., Favrow, L. H., Hamada, Y., Wayman, C. M.
Materials Research Society, Pittsburgh, PA
Proc Symp Mater Res Soc 213, 493-8, 1991 (AD-D145 311)
Key Words: Al(3)Ti, Al-25 at pct Ti-7.5 at pct Fe, microstructure, dislocation structure, compressive properties, fracture surface, intergranular fracture, brittle fracture

3. **Fatigue and Fracture of Intermetallic Alloys**
Cooper, C. V., Inoue, H. E., Giamei, A. F., Favrow, L. H.
United Technologies Research Center, East Hartford, CT
Annual Report
Rept No : R91-917992-2, 47 pp., 1991 (AD-A238 686)
Key Words: Al(3)Ti, turbine components, iron addition, copper addition, nickel addition, phase transformation, microstructure, fatigue, fracture

4. **Elastic Modulus of NiAl-TiB(2) Composites in the Temperature Range 300 to 1273 K**
Viswanadham, R. K., Mannan, S. K., Kumar, K. S.
J Mater Sci Lett 8 (4), 409-10, 1989 (AD-D140 949)
Key Words: NiAl, boride addition, modulus of elasticity

5. **The Effect of 0.1 Atomic Percent Zirconium on the Cyclic Oxidation Behavior of Beta-NiAl for 3000 Hours at 1200 C**
Barrett, C. A.
National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Technical Memorandum
Rept No : NASA-TM-101408, 18 pp., 1989 (AD-D141 688)
Key Words: NiAl, zirconium addition, microstructure, spalling, cyclic test, oxidation, long term tests

6. **Investigation of As-Cast and Rapidly Solidified Al(3)Sc**
Tamacki, J., Kim, Y.W.
Scr Metall 23 (7), 1063-8, 1989 (AD-D142 932)
Key Words: Al(3)Sc, microscopy, melt spinning, hardness, compressive properties

7. **Environmental Effects in Niobium Base Alloys and other Selected Intermetallic Compounds**
Meier, G. H., Thompson, A. W.
Department of Materials Science and Engineering, Pittsburgh University, PA
Annual Report Number One
Rept No : AFOSR-TR-89-0366, 68 pp., 1988 (AD-A206 072)
Key Words: NbAl(3), Nb-21Ti-10Al-15Si, Ti-24Al-11Nb, Nb-21Ti-25Si, Nb-25Ti-12.5Al-25Si, Nb-25Ti-12.5Ta-12.5Al-25Si, turbine components, tensile properties, fracture toughness, crack growth

8. **Progress of Powder Metallurgy in North America**
Roll, K.H., Johnson, P.K.
Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

9. **R&D on Composition and Processing of Titanium Aluminide Alloys for Turbine Engines**
Blackburn, M. J., Smith, M. P.
Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
Interim Report
Rept No : PWA-FR-16259, 103 pp., 1982 (AD-B069 620)
Key Words: TiAl, Ti(3)Al, Ti-25Al-10Nb-3V-1Mo, Ti-48 at pct Al-1 at pct V, turbine components, aluminides, microstructure, modulus, tensile properties, creep rupture, Charpy impact, fatigue, fracture toughness, thermal properties

10. **Rolling, Forming and Joining Titanium-Aluminide Sheet**
Bhatt, D. D., Meyer, G. E., Hoffmanner, A. L.
Battelle Memorial Institute, Columbus, OH
Final Report
Rept No : AFML-TR-78-59, 130 pp., 1978 (AD-B031 214)
Key Words: Ti-16Al-10Nb, Ti-12Al-19Nb, Ti-13Al-20Nb, Ti-36Al-5Nb, Ti-32Al-5Nb-5W, rolling, superplastic forming, joining, tensile properties, hardness, fatigue, creep test, bend test

11. **Materials and Processing Technology for Advanced Gas Turbines**
Hauser, H. A.
SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

REFRACTORY METALS AND ALLOYS

1. **The Joining of Refractory Metals by Hot Isostatic Pressing**
Werdecker, W., Aldinger, F.
High Temp-High Pressures 14 (2), 183-97, 1982 (AD-D127 724)
Key Words: Inconel 601, Kanthal A-1, molybdenum, stainless steel, dissimilar joining, diffusion bonding, microhardness

2. **Processing: The Rediscovered Dimension in High Temperature Alloys**
Semchyshen, M.
Standardization News 4 (4), 9-19, 1976 (AD-D110 676)
Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

3. **Processing and Characterization of Several Tungsten Alloys**
Hall, R. C., Ossin, A., Ammon, R. L., Buckman, R. W., Aronin, L.
Proc 20th National SAMPE Symp and Exhibition, 13 pp., 1975 (AD-D107 039)
Key Words: W-10Cu, W-2ThO2, W-4Re, W-0.5HfC, turbine components, leading edges, microstructure, tensile properties, thermal properties

4. **Interdiffusion Behavior of Tungsten or Rhenium and Group V and VI Elements and Alloys of the Periodic Table-Part I**
Arcella, F. G.
Westinghouse Astronuclear Lab, Pittsburgh, PA
Final Report
Rept No : WANL-M-FR-74-005, 248 pp., 1974 (AD-D100 645)
Key Words: tantalum, niobium, tungsten, T-111, rhenium, dissimilar joining, electron beam welding, pressure bonding, interdiffusion, voids, aging, mathematical model, niobium alloys

5. **Interdiffusion Behavior of Tungsten or Rhenium and Group V and VI Elements and Alloys of the Periodic Table-Part II (Appendices)**
Arcella, F. G.
Westinghouse Astronuclear Lab, Pittsburgh, PA
Final Report
Rept No : WANL-M-FR-74-005, 147 pp., 1974 (AD-D100 713)
Key Words: Nb-1Zr, W-30Re-20Mo, Mo-50Re, T-111, Ta-10W, niobium, tungsten, tantalum, porosity, dissimilar joining, weldability, fracture mechanics, cracking, degradation, diffusivity, interdiffusion

MISCELLANEOUS CAST ALLOYS

1. **Manufacture of Reference Defects for NDE through Hot Isostatic Pressing**
   Sinclair, A.N., Graf, M., Moles, M.C., Doleby, M., DaSilva, V.
   Review of Progress in Quantitative Nondestructive Evaluation
   10B, 2235-42, 1991 (AD-D331 425)
   Key Words: Zircaloy, Zr-2.5Nb, pressure tube, fabricated defects

2. **Progress of Powder Metallurgy in North America**
   Roll, K.H., Johnson, P.K.
   Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
   Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

3. **A Retrospective View of Metallurgy During the 25 Years of the Gillett Lectures**
   Jaffee, R. I.
   Standardization News 5 (1), 9-22, 1977 (AD-D108 834)
   Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement, fracture mechanics

4. **Hot Isostatic Pressure Healing of Navy Gun Metal Castings**
   Seifert, D. A., Hanes, H. D.
   Battelle Memorial Institute, Columbus, OH
   Final Report
   Contract No : N00024-73-C-5375
   41 pp., 1974 (AD-787 598)
   Key Words: copper alloy 903, gun metal, microstructure, porosity, defects, tensile properties

3. Miscellaneous

ALUMINUM ALLOYS

1. **Applications of Coating Technology and HIP to Advanced Materials Processing**
Nicholls, J. R., Stephenson, D. J.
Mater High Temp 9 (2), 110-20, 1991
Key Words: nickel, copper, phosphor bronze, Ni-13Al, MAR-M002, AA 7075, AA 8090, silver, Inconel 625, ion plating, electron beam evaporation, coatings, microstructure, creep, diffusion bonding

2. **The Influence of Specimen Geometry on Near Threshold Fatigue Crack Growth**
Vecchio, R. S., Crompton, J. S., Hertzberg, R. W.
Fatigue Fract Eng Mater Struct 10 (4), 333-42, 1987 (AD-D137 808)
Key Words: Udimet 700, AA 2024-T3, grain size, crack growth, fatigue crack

3. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

4. **Dual-Property T63 Turbine Rotor**
Ewing, B. A., Jain, S. K.
General Motors Corp., Allison Gas Turbine Operations, Indianapolis, IN
Final Report Mar 81-Apr 84
Rept No : USAAVSCOM-TR-84-D-18, 166 pp., 1984 (AD-B089 072L)
Key Words: nickel alloys, aluminum alloys, steels, T63 turbine components, defects, fatigue, fabrication, cracking, fracture, ultrasonic testing, stress analysis

5. **Metalforming's Big Push to Systems Technologies**
Larsen, R. J., Harvey, R. E., Post, C. T., Weimer, G. A., LeCerf, B. H.
Iron Age 222 (43), 53-63, 1979 (AD-D116 917)
Key Words: Ti-6Al-4V, copper, aluminum, stainless steel, superplastic forming, diffusion bonding

6. **Research to Conduct an Exploratory Experimental and Analytical Investigation of Alloys**
Ruckle, D. L.
Pratt and Whitney Aircraft Group, East Hartford, CT
Third Quarterly Report, Aug-Nov 75
Rept No : EII-75-200-4001-2, 55 pp., 1975 (AD-D108 084L)
Key Words: Ti-16Al-10Nb, aluminum alloys, turbine components, microstructure, thermal properties, fracture, hardness, fatigue, tensile properties, creep rupture, notch properties

Miscellaneous Stainless Steels

1. **Superplasticity and Hardening of Extremely Fine Grained Ultrahigh Carbon-Chromium-Vanadium-Iron Alloys**
   Frommeyer, G.
   Pergamon Press, Elmsford, NY
   Proc 7th Int Conf Strength of Metals and Alloys
   ICSMA 7-V-2, 877-84, 1986 (AD-D139 304)
   Key Words: 5Cr steel, 18Cr stainless, forging, atomization, tensile properties, rapid solidification

2. **Application of Diffusion Welding in the USA**
   Weld J 60 (2), 22-33, 1981 (AD-D120 554)
   Owczarski, W. A. Paulonis, D. F.
   Key Words: Pyromet X-15, T-111, Ti-6Al-4V, diffusion welding, bonding, dissimilar joining

3. **An Investigation of Diffusion Bonding of Titanium to Stainless Steel**
   Chen, C. C.
   Metallurgical Society of AIME, Warrendale, PA
   Proc 4th Int Conf Titanium, Titanium'80-Science and Technology
   4, 2379-88, 1980 (AD-D121 360)
   Key Words: titanium, AISI 304, dissimilar joining, diffusion bonding, microhardness

4. **Ultrasonic Inspectability Improvement of Austenitic Stainless Steel Welds After Thermal Mechanical Processing**
   Malif, R.K., Lott, L.A.
   NDT for Energy Progress 66-70, 1980 (AD-D310 104)
   Key Words: stainless steel, welds, microstructure, mechanical properties

5. **Metalforming's Big Push to Systems Technologies**
   Larsen, R. J., Harvey, R. E., Post, C. T., Weimer, G. A., LeCerf, B. H.
   Iron Age 222 (43), 53-63, 1979 (AD-D116 917)
   Key Words: Ti-6Al-4V, copper, aluminum, stainless steel, superplastic forming, diffusion bonding

6. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
   Herman, H.
   State University of New York at Stony Brook, Department of Materials Sciences, NY
   Final Report
   Contract No : N00014-78-M-0074
   58 pp., 1978 (AD-A061 867)
   Key Words: Ti-6Al-4V, HY-130, AISI 304, Udimet 700, creep-fatigue, crack detection

7. **Technological Considerations in the Forging of Superalloy Rotor Parts**
Wilkinson, N. A.
Met Technol 4 (7), 346-59, 1977 (AD-D110 651)
Key Words: Waspaloy, Udimet 700, Inconel 718, A-286, grain size, grain boundaries, thermomechanical treatment, notch sensitivity tensile properties, creep properties, fatigue size, Charpy impact, dislocation structure

8. **Compositional and Structural Aspects of Processing Nickel-Base Alloys**
Knott, A. R., Symonds, C. H.
Met Technol 3 (8), 370-9, 1976 (AD-D103 973)
Key Words: Monel 400, Nimonic 75, Nimonic 80A, Nimonic 90, Nimonic 105 Nimonic 115, Nimonic PE13, Inconel 600, Inconel 718, Incoloy 800, Incoloy 825, microstructure, deformation, segregation, grain size

9. **Materials Research for Superconducting Machinery-IV**
Reed, R. P., Clark, A. F., Van Reuth, E. C.
National Bureau of Standards, Cryogenics Division, Boulder, CO
Semi-Annual Technical Report
Contract No : ARPA Order-2569
636 pp., 1975 (AD-A019 230)
Key Words: niobium alloys, titanium alloys, AISI 310, Inconel X-750, Inconel 706, Inconel 718, Incoloy 903, AA 6061, A-286, Invar, Kromarc 58, 21-6-9 steel, tensile properties, fatigue

Miscellaneous Steels

1. **HIPing Effects for Steel's Mechanical Properties**
Ona, H., Ichikawa, S., Anndou, T., Nishioka, K.
Elsevier, London, UK
Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl 275-80, 1991
Key Words: S45C, tensile properties, hardness, heat treatment

2. **Additional Fracture and Strength Test Results for A723 Steel and 38644 Titanium**
Underwood, J. H., Kamdar, M. H., Fujczak, R. R.
Benet Labs, Army Armament Research Development and Engineering Center, Watervliet, NY
Final Report
Rept No : ARCCB-TR-88018, 21 pp., 1988 (AD-A196 329)
Key Words: A723, 38644, cylinders, pressure vessels, fracture toughness, fatigue, crack growth, notch fatigue, burst test, aluminum coating

3. **Superplasticity and Hardening of Extremely Fine Grained Ultrahigh Carbon-Chromium-Vanadium-Iron Alloys**
Frommeyer, G.
Pergamon Press, Elmsford, NY
Proc 7th Int Conf Strength of Metals and Alloys
ICSMA 7-V-2, 877-84, 1986 (AD-D139 304)
Key Words: 5Cr steel, 18Cr stainless, forging, atomization, tensile properties, rapid solidification

4. **Dual-Property T63 Turbine Rotor**
Ewing, B. A., Jain, S. K.
General Motors Corp., Allison Gas Turbine Operations, Indianapolis, IN
Final Report Mar 81-Apr 84
Rept No : USAAVSCOM-TR-84-D-18, 166 pp., 1984 (AD-B089 072L)
Key Words: nickel alloys, aluminum alloys, steels, T63 turbine components, defects, fatigue, fabrication, cracking, fracture, ultrasonic testing, stress analysis

5. **HIP Clad Nickel Base Alloy 625 for Deep Sour Wells**
Uhl, W. K., Pendley, M. R.
Materials Performance 23 (5), 30-4, 1984 (AD-D129 874)
Key Words: Inconel 625, AISI 4130, cladding, corrosion, tensile properties, dissimilar joining

6. **Metallography of Hot Isostatically Pressed Materials**
Piske, D., Wittner, I., Seilstorfer, H.
Pract Metall 20 (7), 342-9, 1983 (AD-D128 809)
Key Words: X 225 CrVMo 13 4, 5Cr steel, Stellite 6, tool steel, porosity, microstructure

7. **Analysis an Verification of Fracture Mechanics Criteria for a Large Monobloc High Pressure Vessel**
Bishop, R. J., Khare, A. K., Mraz, G. J.
J Mater Energy Syst 4 (2), 92-8, 1982 (AD-D126 500)
Key Words: 3.5Ni steel, fracture mechanics, tensile properties, fracture toughness, impact properties, fatigue, crack growth

8. **Atom-Probe Microanalysis of a Tempered High-Speed Steel**
Audren, H-O.
Scr Metall 15 (7), 749-52, 1981 (AD-D121 730)
Key Words: Fe-2.2C-10Co-7Mo-7W-6V-4Cr, martensite, precipitation, tempering, microprobe analysis

9. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
Herman, H.
State University of New York at Stony Brook, Department of Materials Sciences, NY
Final Report
Contract No : N00014-78-M-0074
58 pp., 1978 (AD-A061 867)
Key Words: Ti-6Al-4V, HY-130, AISI 304, Udimet 700, creep-fatigue, crack detection

10. **Establishment of Production Machinability Data**
Zlatin, N., Field, M., Tipnis, V. A., Garrison, R. C., Christopher, J. D.
Final Report, 13 Jul 73-Aug 75
Rept No : 1400-20300, 441 pp., 1975 (AD-A050 904)
Key Words: tool steel, cladding pressure vessels, defects, welding

11. **Materials Research for Superconducting Machinery-IV**
Reed, R. P., Clark, A. F., Van Reuth, E. C.
National Bureau of Standards, Cryogenics Division, Boulder, CO
Semi-Annual Technical Report
Contract No : ARPA Order-2569
636 pp., 1975 (AD-A019 230)
Key Words: niobium alloys, titanium alloys, AISI 310, Inconel X-750, Inconel 706, Inconel 718, Incoloy 903, AA 6061, A-286, Invar, Kromarc 58, 21-6-9 steel, tensile properties, fatigue

12. **Development of a Gas Pressure Bonded Four-Pole Altenator Rotor**
Lessmann, G. G., Bryant, W. A.
Westinghouse Astronuclear Lab, Pittsburgh, PA
Final Report
Rept No : WANL-M-FR-72-002. 81 pp., 1972 (AD-D101 258)
Key Words: AISI 4340, Inconel 718, welding, bonding, fabrication

NICKEL ALLOYS

IN-100

1. **Fatigue and Creep-Fatigue Deformation of Several Nickel-Base Superalloys at 650 C**
   Miner, R., Gayda, J., Maier, R. D.
   Metall Trans 13A (10), 1755-65, 1982 (AD-D125 930)
   Key Words: Waspaloy, Udimet 700, RENE' 95, IN-100, MERL 76, NASA IIB-7, turbine components, microstructure, creep-fatigue, slip

2. **The Evolution of the Forging Processes on Discs**
   Coyne, J. E., Couts, W. H., Jr.
   Kluwer Boston Inc., Hingham, MA
   Proc Conf High Temperature Alloys for Gas Turbines 839-52, 1982 (AD-D134 023)
   Key Words: Waspaloy, Inconel 718, IN-100, RENE' 95, MERL 76, Udimet 700, tensile properties, creep rupture, fatigue

3. **Forging and Processing of High-Temperature Alloys**
   DeRidder, A. J., Koch, R., ASTM, Philadelphia, PA
   Proc Symp MiCon 78 547-63, 1979 (AD-D126 410)
   Key Words: RENE' 95, Waspaloy, Inconel 718, IN-100, microstructure, thermomechanical treatment

4. **Original HCl Surface Treatment for Diffusion Bonding of Nickel Superalloy Specimens**
   Billard, D., Trottier, J. P., Met Technol 5 (9), 309-19, 1978 (AD-D114 028)
   Key Words: IN-100, Waspaloy, RENE' 95, Inconel 718, welding, grain size, bonding, recrystallization, temperature effect

Inconel 718

1. **Advanced Machining Research Program (AMRP). Volume 4 Laser-Assisted Machining**
   Flom, D. G.
   General Electric Corporate Research and Development, Schenectady, NY
   Rept No : AFWAL-TR-84-4059-Vol-4, 75 pp., 1984 (AD-B087 672L)
   Key Words: Inconel 718, Ti-6Al-4V, laser machining, turning, machine tools

2. **The Evolution of the Forging Processes on Discs**
   Coyne, J. E., Couts, W. H., Jr.
   Kluwer Boston Inc., Hingham, MA
   Proc Conf High Temperature Alloys for Gas Turbines 839-52, 1982 (AD-D134 023)
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3. **Forging and Processing of High-Temperature Alloys**
   DeRidder, A. J., Koch, R.
   ASTM, Philadelphia, PA
   Proc Symp MiCon 78 547-63, 1979 (AD-D126 410)
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Billard, D., Trottier, J. P.
Met Technol 5 (9), 309-19, 1978 (AD-D114 028)
Key Words: IN-100, Waspaloy, RENE' 95, Inconel 718, welding, grain size, bonding, recrystallization, temperature effect

5. **Forging and Properties of Aerospace Materials**
Metallurgia and Metal Forming 44 (6), 251-6, 1977 (AD-D110 439)
Key Words: Ti-10Mo-6Cr-2.5Al, Ti-7Mo-4Cr-2.5Al, Ti-10Mo-8V-2.5Al IMI 679, IMI 685, Ti-6Al-2Sn-4Zr-2Mo, Ti-10V-2Fe-3Al, Inconel 718, Waspaloy, Incoloy 901, fatigue, crack growth

6. **Technological Considerations in the Forging of Superalloy Rotor Parts**
Wilkinson, N. A.
Met Technol 4 (7), 346-59, 1977 (AD-D110 651)
Key Words: Waspaloy, Udimet 700, Inconel 718, A-286, grain size, grain boundaries, thermomechanical treatment, notch sensitivity tensile properties, creep properties, fatigue size, Charpy impact, dislocation structure

7. **Compositional and Structural Aspects of Processing Nickel-Base Alloys**
Knott, A. R., Symonds, C. H.
Met Technol 3 (8), 370-9, 1976 (AD-D103 973)
Key Words: Monel 400, Nimonic 75, Nimonic 80A, Nimonic 90, Nimonic 105 Nimonic 115, Nimonic PE13, Inconel 600, Inconel 718, Incoloy 800, Incoloy 825, microstructure, deformation, segregation, grain size

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Reed, R. P., Clark, A. F., Van Reuth, E. C.
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Contract No : ARPA Order-2569
636 pp., 1975 (AD-A019 230)
Key Words: niobium alloys, titanium alloys, AISI 310, Inconel X-750, Inconel 706, Inconel 718, Incoloy 903, AA 6061, A-286, Invar, Kromarc 58, 21-6-9 steel, tensile properties, fatigue

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Final Report
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Key Words: AISI 4340, Inconel 718, welding, bonding, fabrication

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ASTM Committee E-24 on Fracture Testing, Philadelphia, PA
Proc 18th National Symp Fracture Mechanics ASTM-STP-945
192-205, 1988 (AD-D143 462)
Key Words: RENE' 95, forging, cyclic loading, fatigue, crack closure

2. **Fatigue and Creep-Fatigue Deformation of Several Nickel-Base Superalloys at 650 C**
Miner, R., Gayda, J., Maier, R. D.
Metall Trans 13A (10), 1755-65, 1982 (AD-D125 930)
Key Words: Waspaloy, Udimet 700, RENE' 95, IN-100, MERL 76, NASA IIB-7, turbine components, microstructure, creep-fatigue, slip

3. **The Evolution of the Forging Processes on Discs**
Coyne, J. E., Couts, W. H., Jr.
Kluwer Boston Inc., Hingham, MA
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Key Words: Waspaloy, Inconel 718, IN-100, RENE' 95, MERL 76, Udimet 700, tensile properties, creep rupture, fatigue

4. **Aircraft Jet Engine Research Aims at Lighter, Dual-Property Disks**
Weintraub, P.
American Metal Market/Metalworking News 87 (167), 10, 13, 1979 (AD-D116 267)
Key Words: RENE' 95, AF-113, AF-115, turbine components, grain structure

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DeRidder, A. J., Koch, R.
ASTM, Philadelphia, PA
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Key Words: RENE' 95, Waspaloy, Inconel 718, IN-100, microstructure, thermomechanical treatment

6. **Original HCl Surface Treatment for Diffusion Bonding of Nickel Superalloy Specimens**
Billard, D., Trottier, J. P.
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Key Words: IN-100, Waspaloy, RENE' 95, Inconel 718, welding, grain size, bonding, recrystallization, temperature effect

7. **Material for Advanced Turbine Engines-MATE**
Bamberger, E. N., Mosier, J. S.
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Rept No : R77AEG425, 50 pp., 1977 (AD-D109 957)
Key Words: RENE' 95, Compressor discs, tensile properties, creep rupture, chemical milling, machining, microstructure, density, solution heat treatment

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Evans, D. J.
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Key Words: Udimet 700, RENE' 95, Ti-6Al-4V, turbine components, tensile properties, creep rupture, net shape forming

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   Key Words: Udimet 700, AA 2024-T3, grain size, crack growth, fatigue crack

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   Author Anon
   Foreign Technology Division, Wright-Patterson AFB, OH
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   Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

3. **Fatigue and Creep-Fatigue Deformation of Several Nickel-Base Superalloys at 650 C**
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   Key Words: Udimet 700, cylinders, microstructure, gamma prime, deformation, compressive properties, thermomechanical treatment

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   State University of New York at Stony Brook, Department of Materials Sciences, NY
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   Key Words: Ti-6Al-4V, HY-130, AISI 304, Udimet 700, creep-fatigue, crack detection

7. **Oxide Dispersion Strengthened Alloys**
   Gessinger, G. H.
   Applied Sciences Publishers Ltd., London, UK
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   Key Words: IN-738, IN-738LC, Udimet 700, Nimonic 80A, turbine components, oxide dispersion strengthening, tensile properties, corrosion, thermal fatigue, hardness, grain growth

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Wilkinson, N. A., Met Technol 4 (7), 346-59, 1977 (AD-D110 651)
Key Words: Waspaloy, Udimet 700, Inconel 718, A-286, grain size, grain boundaries, thermomechanical treatment, notch sensitivity tensile properties, creep properties, fatigue size, Charpy impact, dislocation structure

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Waspaloy

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Key Words: Ti-10Mo-6Cr-2.5Al, Ti-7Mo-4Cr-2.5Al, Ti-10Mo-8V-2.5Al IMI 679, IMI 685, Ti-6Al-2Sn-4Zr-2Mo, Ti-10V-2Fe-3Al, Inconel 718, Waspaloy, Incoloy 901, fatigue, crack growth

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1. **Applications of Coating Technology and HIP to Advanced Materials Processing**
   Nicholls, J. R., Stephenson, D. J.
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   Key Words: nickel, copper, phosphor bronze, Ni-13Al, MAR-M002, AA 7075, AA 8090, silver, Inconel 625, ion plating, electron beam evaporation, coatings, microstructure, creep, diffusion bonding

2. **Hot Isostatic Pressing of PM and Cast Components**
   Stephenson, D. J., Downing, M.
   Mater High Temp 9 (2), 59-68, 1991
   Key Words: IN-792, IMI 829, IMI 318, IN-738, Alloy 713C, Ti-6Al-4V, nickel, tensile properties, defects, near net shape forming, fatigue, density

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   Key Words: nickel alloys, turbine components, crack growth, fatigue vacuum induction, electroslag, electron beam melting

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   Author Anon
   Foreign Technology Division, Wright-Patterson AFB, OH
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   General Motors Corp., Allison Gas Turbine Operations, Indianapolis, IN
   Final Report Mar 81-Apr 84
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   Key Words: nickel alloys, aluminum alloys, steels, T63 turbine components, defects, fatigue, fabrication, cracking, fracture, ultrasonic testing, stress analysis

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Key Words: Waspaloy, Inconel 718, IN-100, RENE' 95, MERL 76, Udimet 700, tensile properties, creep rupture, fatigue

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Key Words: AF-115, turbine components, creep rupture, tensile properties

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Key Words: RENE' 95, AF-115, AF-115, turbine components, grain structure

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13. **Forging and Properties of Aerospace Materials**
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Key Words: Ti-10Mo-6Cr-2.5Al, Ti-7Mo-4Cr-2.5Al, Ti-10Mo-8V-2.5Al IMI 679, IMI 685, Ti-6Al-2Sn-4Zr-2Mo, Ti-10V-2Fe-3Al, Inconel 718, Waspaloy, Incoloy 901, fatigue, crack growth

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Key Words: Monel 400, Nimonic 75, Nimonic 80A, Nimonic 90, Nimonic 105 Nimonic 115, Nimonic PE13, Inconel 600, Inconel 718, Incoloy 800, Incoloy 825, microstructure, deformation, segregation, grain size

15. **Materials Research for Superconducting Machinery-IV**
Reed, R. P., Clark, A. F., Van Reuth, E. C.
National Bureau of Standards, Cryogenics Division, Boulder, CO
Contract No : ARPA Order-2569, 636 pp., 1975 (AD-A019 230)
Key Words: niobium alloys, titanium alloys, AISI 310, Inconel X-750, Inconel 706, Inconel 718, Incoloy 903, AA 6061, A-286, Invar, Kromarc 58, 21-6-9 steel, tensile properties, fatigue

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Dunn, E. L., Bartos, J. L.
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Interim Engineering Progress Report Number Two, Jan-Mar 73
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Key Words: nickel alloys, cobalt addition, chromium addition, development, creep rupture strength, heat treatment

TITANIUM ALLOYS

Ti-6Ai-4V

1. **Hot Isostatic Pressing of PM and Cast Components**
   Stephenson, D. J., Downing, M.
   Mater High Temp 9 (2), 59-68, 1991
   Key Words: IN-792, IMI 829, IMI 318, IN-738, Alloy 713C, Ti-6Al-4V, nickel, tensile properties, defects, near net shape forming, fatigue, density

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   Author Anon
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   Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 !50L)
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   Flom, D. G.
   General Electric Corporate Research and Development, Schenectady, NY
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   Key Words: Inconel 718, Ti-6Al-4V, laser machining, turning, machine tools

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   Owczarski, W. A. Paulonis, D. F.
   Key Words: Pyromet X-15, T-111, Ti-6Al-4V, diffusion welding, bonding, dissimilar joining

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   Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
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   Rept No : NASA-CR-165586, 83 pp., 1981 (AD-D125 625)
   Key Words: Ti-6Al-4V, turbofan engine, fan blades, superplastic forming, diffusion bonding, tensile properties, fatigue

6. **Influe[illegible] of Manufacturing Method and Surface Condition on the Fatigue Strength of Ti-6A[illegible] Material**
   Broichhausen, J., Telfah, M.
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   Key Words: Ti-6Al-4V, fatigue, surface roughness, microhardness

7. **Welding for Low-Cost Advanced Titanium Airframe Structures**
   Messler, R. W., Jr., Paez, C. A.
   American Institute of Aeronautics and Astronautics, New York, NY
   Technical Paper
   Rept No : A82-23757, 16 pp., 1980 (AD-D126 682)
   Key Words: Ti-6Al-4V, Ti-6Al-[illegible] V-2Sn, aircraft structures, welding, diffusion bonding, superplastic forming, net shape forming

8. **Advances in Manufacturing Technology for Titanium Aircraft Structures**
Highberger, W. T.
Metal Prog 115 (3), 56-59, 1979 (AD-D114 858)
Key Words: Ti-6Al-6V-2Sn, Ti-6Al-4V, Corona-5, Ti-4.5Al-5Mo-1.5Cr, aircraft structures, net shape forming, superplastic forming, diffusion bonding

9. **Metalforming's Big Push to Systems Technologies**
Larsen, R. J., Harvey, R. E., Post, C. T., Weimer, G. A., LeCerf, B. H.
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Key Words: Ti-6Al-4V, copper, aluminum, stainless steel, superplastic forming, diffusion bonding

10. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
Herman, H.
State University of New York at Stony Brook, Department of Materials Sciences, NY
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58 pp., 1978 (AD-A061 867)
Key Words: Ti-6Al-4V, HY-130, AISI 304, Udimet 700, creep-fatigue, crack detection

11. **Built-Up Low-Cost Advanced Titanium Structures (BLATS)**
Grumman Aerospace Corp., Bethpage, NY
Technical Bulletin Number Five
Contract No : F33615-77-C-3109
9 pp., 1978 (AD-D113 992)
Key Words: Ti-6Al-4V, Ti-15V-3Cr-3Al-3Sn, aircraft structures, superplastic forming, diffusion bonding, bend test, nondestructive testing, cost

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Clauer, A. H., Leis, B. N., Love, R. B., Seifert, D. A., Hanes, H. D.
Battelle Memorial Institute, Columbus, OH
Interim Report
Rept No : AFML-TR-77-107, 1977, 96 pp. (AD-D108 289)
Key Words: Ti-6Al-4V, turbine components, aircraft structures, microstructure, metallography, rejuvenation, fatigue, crack growth, titanium coatings, nickel coatings, hardness, solution heat treatment

13. **Application of Hot Isostatic Pressing to Aircraft Gas Turbines**
Evans, D. J.
Plenum Press, New York, NY
Proc 6th AIRAPT Int High Pressure Conf 2, 656-63, 1977 (AD-D126 192)
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Miscellaneous Titanium Alloys

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2. **Additional Fracture and Strength Test Results for A723 Steel and 38644 Titanium**
Underwood, J. H., Kamdar, M. H., Fujczak, R. R.
Benet Labs, Army Armament Research Development and Engineering Center, Watervliet, NY
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Rept No : ARCCB-TR-88018, 21 pp., 1988 (AD-A196 329)
Key Words: A723, 38644, cylinders, pressure vessels, fracture toughness, fatigue, crack growth, notch fatigue, burst test, aluminum coating

3. **Microstructural Coarsening at High Temperatures in Rapidly Solidified Ti-5wt.%Al-2.9wt.%Y and Ti-5wt.%Al-7.5wt.%Th**
Whang, S. H., Park, W. W., Kim, P. K., Kim, D. H.
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Key Words: Ti-5Al, grain structure, melt spinning, hardness

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Chen, C. C.
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Proc 4th Int Conf Titanium, Titanium'80-Science and Technology
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Key Words: titanium, AISI 304, dissimilar joining, diffusion bonding, microhardness

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Greenspan, J.
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Proc Army Symp Solid Mechanics, 1980, Designing for Extremes: Enviroment, Loading, and Structural Behavior.
10 pp., 1980 (AD-D124 077)
Key Words: Ti-6Al-6V-2Sn, projectiles, shells, tensile properties, impact properties, firing test, diffusion bonding

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Messler, R. W., Jr., Paez, C. A.
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Paez, C. A.
Grumman Aerospace Corp., Bethpage, NY
Final Technical Report Oct 77-Apr 79
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Key Words: titanium alloys, forging, cost analysis, fatigue, machinability

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Highberger, W. T.
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Quarterly Progress Report Number One, Oct 77-Jan 78
Contract No : F33615-77-C-3109
170 pp., 1978 (AD-D108 269L)
Key Words: titanium alloys, aluminum addition, vanadium addition, superplastic forming, welding, design, tooling, weight change

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Paez, C.
Grumman Aerospace Corp., Bethpage, NY
Quarterly Progress Report Number Four, Jul-Oct 78
Contract No : F33615-77-C-3109
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Key Words: Ti-15Al-3Cr-3Al-3Sn, weight reduction, fracture, tensile properties, damage tolerance

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Ruckle, D. L.
Pratt and Whitney Aircraft Group, East Hartford, CT
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Rept No : EII-75-200-4001-2, 55 pp., 1975 (AD-D108 084L)
Key Words: Ti-16Al-10Nb, aluminum alloys, turbine components, microstructure, thermal properties, fracture, hardness, fatigue, tensile properties, creep rupture, notch properties

14. **Materials Research for Superconducting Machinery-IV**
Reed, R. P., Clark, A. F., Van Reuth, E. C.
National Bureau of Standards, Cryogenics Division, Boulder, CO
Semi-Annual Technical Report
Contract No : ARPA Order-2569
636 pp., 1975 (AD-A019 230)
Key Words: niobium alloys, titanium alloys, AISI 310, Inconel X-750, Inconel 706, Inconel 718, Incoloy 903, AA 6061, A-286, Invar, Kromarc 58, 21-6-9 steel, tensile properties, fatigue

INTERMETALLIC COMPOUNDS

1. **Flow Softening and Microstructure Evolution during Hot Working of Wrought Near-Gamma Titanium Aluminides**
   Semiatin, S. L., Frey, N., El-Soudani, S. M., Bryant, J. D.
   Metall Trans A 23A, 1719-35, 1992
   Key Words: TiAl, Ti-48 at pct Al-2.5 at pct Nb, Ti-48 at pct Al-2 at pct Nb-2 at pct Cr, isothermal forging, hot compression test

2. **Recent Advances in Gamma Titanium Aluminide Alloys**
   Kim, Y-W.
   Materials Research Society, Pittsburgh, PA
   Proc Symp Mater Res Soc 213, 777-94, 1991 (AD-D145 352)
   Key Words: TiAl, Ti(3)Al, NiAl, Ni-48 at pct Al, Ni-48 at pct Al-2 at pct Nb, crystal structure, phase diagram, microstructure, grain size, tensile properties, fracture toughness, oxidation, crack growth, creep, thermomechanical treatment, fracture surface

REFRACTORY METALS AND ALLOYS

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   Weld J 60 (2), 22-33, 1981 (AD-D120 554)
   Owczarski, W. A. Paulonis, D. F.
   Key Words: Pyromet X-15, T-111, Ti-6Al-4V, diffusion welding, bonding, dissimilar joining

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3. **Tensile Properties from Room Temperature to 1315 Degrees C of Tungsten-Lined Tantalum-Alloy (T-111) Tubing Fabricated by Hot Isostatic Pressing**
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