DECLASSIFIED
Authority NND 63208

SECRET

STRUCTURAL MATERIALS (AIRCRAFT, SPACECRAFT, AND MISSILES) - USSR (U)

Authors: *R. F. Frontani*
C. E. Butler
F. G. Jacocks

ST-CS-01-44-69

DIA TASK NO. T68-01-02

15 AUGUST 1969

This study supersedes DIA Task Numbers T65-01-77, T65-01-78, T65-01-79, T65-01-80 and T65-01-81

WARNING: This document contains information affecting the national defense of the United States within the meaning of the Espionage Law, Title 18, U.S.C., Sections 793 and 794. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

This is a Department of Defense Intelligence Product prepared and published by the USAF Foreign Technology Division with a contribution from the Missile Intelligence Directorate. This product has been reviewed and approved by the Director, Defense Intelligence Agency.

NO FOREIGN DISSEMINATION

DECLASSIFIED
Authority NND 63003

ST-CS-01-44-69
15 August 1969

PREFACE

(S) This study has been written in response to DIA Task No. T68-01-02, dated 28 March 1968. The purpose of this product is to provide an evaluation of the Soviet capability in material technology as related to present and future aircraft, spacecraft, and missile structural and propulsion applications. Significant Soviet developments are described for both metallic and nonmetallic material areas. A 15-year forecast is included where appropriate.

(C) Although the majority of data was obtained from open literature sources, appropriate intelligence reports and material exploitation reports were also analyzed. Specifically, the following material areas are covered: aluminum, titanium, magnesium, beryllium, low-alloy steels, stainless steels, maraging steels, superalloys, refractory metal alloys, ceramics, and composite materials. In addition, related coating systems and processing developments (such as thermal mechanical treatment) are evaluated. In order to be consistent with Soviet publications, chromium-base alloys are included as refractory metal alloys in the study.

(S) In the performance of this task, assistance was requested and received from the Army Missile Intelligence Directorate in the form of a contribution covering Soviet SA-2 material application.

(U) The cutoff date for the information contained in this study is 15 January 1969.

TABLE OF CONTENTS

Page No.

Preface iii

Summary xi

Section I Light Metals 1

A. Aluminum Alloys 1
B. Titanium Alloys 3
C. Magnesium Alloys 4
D. Beryllium Alloys 6

Section II Steels and Copper 9

A. Low-Alloy Steels 9
B. Maraging Steels 10
C. Stainless Steels 11

1. Austenitic 11
2. Martensitic Stainless Steels . . . . .
3. Precipitation-Hardenable Stainless Steels . . . . .

D. Copper Alloys 15

Section III Superalloys 17

A. Background 17
B. Alloy Development and Application 17

1. Wrought 17
2. Cast Alloys 18
3. Sheet Alloys 18
4. Deficiencies in Soviet Alloy Development 19

C. Processing of Superalloy Engine Components 19

1. Cooling 19
2. Coating 20

Section IV Refractory Metal Alloys 23

A. Niobium and Niobium-Base Alloys 23
B. Molybdenum and Molybdenum-Base Alloys 24
C. Tantalum and Tantalum-Base Alloys 27
D. Tungsten and Tungsten-Base Alloys 28
E. Chromium and Chromium-Base Alloys 30
F. Vanadium and Vanadium-Base Alloys 31

Section V Thermal Mechanical Treatment of Metals and Alloys 33

TABLE OF CONTENTS (Cont)

	Page No.
Section VI Ceramics	35
A. Oxides	35
B. Nuclear	35
C. Magnetic	36
D. Graphite	36
E. Coatings	36
F. Glasses and Glass-Ceramics	37
Section VII Composite Materials	39
A. Whiskers and Filaments	39
B. Metal-Matrix	40
C. Dispersion-Strengthened Alloys	41
D. Polymeric Materials	43
E. Polymeric Adhesives	46
F. Filament Winding	49
Appendix Tables and Figures	53
Bibliography	137

LIST OF TABLES

Table	I Probable Soviet Liquid Tankage Materials	55
Table	II Nominal Compositions of Selected Soviet Aluminum Alloys	56
Table	III Properties of Selected Soviet Aluminum Alloys	58
Table	IV Proposed Aluminum Alloy Designation for Selected Alloys	59
Table	V Nominal Chemical Compositions of Selected Soviet Titanium Alloys	60
Table	VI Mechanical and Physical Properties of Selected Titanium Alloys	62
Table	VII Mechanical and Physical Properties of Selected Titanium Alloys at Elevated Temperatures	64
Table	VIII Composition and Properties of Soviet Cast Magnesium Alloys	65
Table	IX Composition and Properties of Soviet Wrought Magnesium Alloys	66
Table	X Nominal Composition of Low-Alloy Steels for Solid Propellant Rocket Motor Cases	67
Table	XI Typical Mechanical Properties of Steels for Solid Propellant Rocket Motor Cases	68

National Security Archive,

Suite 701, Gelman Library, The George Washington University,

2130 H Street, NW, Washington, D.C., 20037,

Phone: 202/994-7000, Fax: 202/994-7005, nsarchiv@gwu.edu