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Material Specification		MSRR8652
Ti - 6Al - 4V ALLOY BARS FOR MACHINING, FORGING STOCK, FORGINGS AND FINISHED PARTS (TENSILE STRENGTH: 900-1160 MPa) (LIMITING RULING SECTION: 150 MM)		PAGE 1 OF 5 PAGES
REFERENCED SPECIFICATIONS		DATE OCTOBER 2017
This Specification MSRR8652 IS CONTROLLED BY MSRR9951 REQUIRES BS.TA100 MSRR9968 MSRR0000 RRP 54000 RRP 51001		APPROVALS: <div style="text-align: center;">Jon Higgins</div> MATERIALS ENGINEERING
<ul style="list-style-type: none"> • This specification shall be interpreted in accordance with MSRR0000 • The chemical composition (with the exception of O2 and N2), heat treatment and mechanical properties of BS TA11, BS TA12 and BS TA13 are equivalent to those of this specification. • Test pieces to MSRR9968. • Inspection and testing procedures shall be in accordance with BS.TA100 Sections 1, 2, 3 and 4 unless this specification overrides • FOR NON-CLASSIFIED PARTS ONLY; Machining Bar to AMS4928 and BS TA11 may be used in lieu of Material 20 of this specification (TEG). LRS of 150 mm still applies. Forging Stock to MSRR8636 may be used in lieu of Material 20, prior to use the stock MUST be reduced to a LRS of 150 mm and Annealed for 700 - 705Cel/=>1h/AC and tested in accordance with Material 21. Forging Stock to AMS4928, BS TA12, prEN2530 and MSRR8636 (NAY) may be used in lieu of Material 30 of this specification (NBH). Forgings to AMS4928, BS TA13, prEN2531 and MSRR8636 (TDK) may be used in lieu of Material 40 of this specification (TEG). FOR SENSITIVE AND CRITICAL PARTS (EXCLUDING ROTATING CRITICAL PARTS); Forging Stock to MSRR8636 (NAY) may be used in lieu of Material 30 of this specification (NBH). No non-conformance documentation is required, but the release note shall state that a substitution has been used. • Material to MSRR8614 may be used in lieu of material to this specification. • Typical Manufacturer's Ref: TITANIUM 318. • CHANGES: For information only, changes since the last issue are recorded on the last page. You are advised not to consider these changes in isolation as other requirements of the specification may be affected by them. 		

This specification contains the following materials:				
Matl. No.	Matl. Code	Form	Material Development Path	Page
20	TEG	B/FP		2
30	NBH	Fs	Can make Material Number 40	3
40	TEG	F/FP		4

Composition

Constituent	Value	Constituent	Value
C	<=0.08 % wt	N	<=0.030 % wt
See Note against Method of Manufacture.		O	0.14 to 0.23 % wt
Al	5.5 to 6.75 % wt	V	3.5 to 4.5 % wt
Fe	<=0.30 % wt	Y	<=50 ppm wt
H	<=0.010 % wt	TITANIUM	REMAINDER

The hydrogen content of material supplied as bars for machining, forging stock and forgings shall not exceed 0.0125%, 0.010% and 0.015% respectively.

Method of Manufacture	
MVAR Skull/VAR PACHM/VAR EBCHM/VAR	The raw materials shall have a total Carbon content of not more than 0.08%.

MATERIAL NUMBER		20
Material Name: Ti64: (B F) LRS=150mm		Material Code: TEG
MATERIAL MANUFACTURE:		
Form	Bars/Finished Parts	
Limit Dimensions	LRS = 150 mm	
Any material or parts which have a ruling section greater than 150 mm shall be supplied in the as manufactured condition.		
Annealing shall not be carried out until the ruling section has been thermomechanically reduced to 150 mm or less, unless otherwise agreed with the Rolls-Royce Materials Engineering Authority.		
SUPPLY:		
Condition and Material Processing	ANNEAL:700-705Cel/=>1h/AC MACHINE or CENTRELESS GRIND ETCH: to RRP 51001 (a)	
(a) Unless otherwise stated by the Rolls-Royce Technical Authority.		
FINAL USE:		
Condition and Material Processing	As Condition of Supply	
NON-DESTRUCTIVE TESTING	To the relevant Method of Manufacture Data Sheet	
MACRO EXAMINATION	No evidence of harmful defects	
This material has 1 test material (see below)		

TEST MATERIAL NUMBER		21 (Tests for Material Number 20)	
Material Name: Ti64: (B F) LRS=150mm		Material Code: TEG	
TEST MATERIAL:			
Condition and Material Processing		As Condition of Supply	
Sampling		BS.TA100	
BATCH TENSILE	DUCTILITY	DUCT_TYPE ELONGATION	>= 8 %
		GAUGE_LENGTH 5.65 ROOT(A)	
		TEMPERATURE 20 Cel	
		DUCT_TYPE RED_OF_AREA	>= 25 %
	GAUGE_LENGTH 5.65 ROOT(A)		
	TEMPERATURE 20 Cel		
	PROOF STRESS	LOADING TENSION	>= 830 MPa
		STRAIN 0.2 %	
		TEMPERATURE 20 Cel	
	ULT STRENGTH	LOADING TENSION	900 to 1160 MPa
		TEMPERATURE 20 Cel	
GRAIN SIZE	Standard acceptance to be agreed with the Rolls-Royce Technical Authority and laid down in the Method of Manufacture Data Sheet		
Finished parts manufactured from bar that has been tested and released to the requirements of Material Number 21 do not require the batch tensile and grain size test to be repeated, providing that heat treatment has been carried out in accordance with RRP 54000.			

MATERIAL NUMBER	30
Material Name: (Fs) Ti64 stock (not HT)	Material Code: NBH

MATERIAL MANUFACTURE:	
Form	Forging Stock
Method of Production	Hot Rolled or Extruded
SUPPLY:	
Condition and Material Processing	As Manufactured MACHINE or CENTRELESS GRIND ETCH: to RRP 51001 (a)
(a) Unless otherwise stated by the Rolls-Royce Technical Authority.	
FINAL USE:	
Condition and Material Processing	Refer to Material 40

NON-DESTRUCTIVE TESTING	To the relevant Method of Manufacture Data Sheet
MACRO EXAMINATION	No evidence of harmful defects

This material has 1 test material (see below)

TEST MATERIAL NUMBER	31 (Tests for Material Number 30)
Material Name: Ti64: (B F) LRS=150mm	Material Code: TEG

TEST MATERIAL:	
Condition and Material Processing	ANNEAL:700-705Cel/=>1h/AC
Sampling	BS TA100

BATCH TENSILE	DUCTILITY	DUCT_TYPE	ELONGATION	>= 8 %
		GAUGE_LENGTH	5.65_ROOT(A)	
		TEMPERATURE	20 Cel	
		DUCT_TYPE	RED_OF_AREA	>= 25 %
		GAUGE_LENGTH	5.65_ROOT(A)	
		TEMPERATURE	20 Cel	
	PROOF_STRESS	LOADING	TENSION	>= 830 MPa
		STRAIN	0.2 %	
		TEMPERATURE	20 Cel	
	ULT_STRENGTH	LOADING	TENSION	900 to 1160 MPa
		TEMPERATURE	20 Cel	
GRAIN SIZE	Standard acceptance to be agreed with the Rolls-Royce Technical Authority and laid down in the Method of Manufacture Data Sheet.			

MATERIAL NUMBER		40		
Material Name: Ti64: (B F) LRS=150mm		Material Code: TEG		
MATERIAL MANUFACTURE:				
Form	Forgings/Finished Parts			
Method of Production	Manufactured from Material 30			
Limit Dimensions	LRS = 150 mm			
Any material or parts which have a ruling section greater than 150 mm shall be supplied in the as manufactured condition.				
Annealing shall not be carried out until the ruling section has been thermomechanically reduced to 150 mm or less, unless otherwise agreed with the Rolls-Royce Materials Engineering Authority.				
SUPPLY:				
Condition and Material Processing	As Manufactured + ANNEAL:700-705Cel/=>1h/AC (a) DESCALE ETCH: to RRP 51001 (b)			
(a) An optional Homogenisation treatment of 945 - 985 Cel/1h/WQ may be carried out when agreed with the Rolls-Royce Technical Authority and stated in the Method of Manufacture Data Sheet.				
(b) Unless otherwise stated by the Rolls-Royce Technical Authority.				
FINAL USE:				
Condition and Material Processing	As Condition of Supply			
NON-DESTRUCTIVE TESTING	To the relevant Method of Manufacture Data Sheet			
MACRO EXAMINATION	Where etch is conducted macro examination shall reveal no evidence of harmful defects			
This material has 1 test material (see below)				
TEST MATERIAL NUMBER		41 (Tests for Material Number 40)		
Material Name: Ti64: (B F) LRS=150mm		Material Code: TEG		
TEST MATERIAL:				
Condition and Material Processing	As Condition of Supply			
Sampling	BS TA100 (a)			
(a) Finished parts machined from forgings previously release tested to the requirements of Test Material Number 41 need not be re-tested, providing that heat treatment has been carried out in accordance with RRP 54000.				
BATCH TENSILE	DUCTILITY	DUCT_TYPE	ELONGATION	>= 8 %
		GAUGE_LENGTH	5.65_ROOT(A)	
		TEMPERATURE	20 Cel	
	PROOF_STRESS	LOADING	TENSION	>= 830 MPa
STRAIN		0.2 %		
TEMPERATURE		20 Cel		
ULT_STRENGTH	LOADING	TENSION	900 to 1160 MPa	
	TEMPERATURE	20 Cel		
DUCTILITY NOTE: The reduction of area value for large rings (>900 mm internal diameter and >100 mm axial length) in axial and radial directions only, shall be >= 20%.				
GRAIN SIZE	Standard acceptance to be agreed with the Rolls-Royce Technical Authority and laid down in the Method of Manufacture Data Sheet			

CHANGES FROM PREVIOUS ISSUE

PAGE 1 For Non-Classified Parts first paragraph “LRS of 150 mm still applies” added.

PAGE 2 Material 20 Material Manufacture note amended,

PAGE 4 Material 40 Material Manufacture note amended.

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