

**REVISIONS**

<b>REV</b>	<b>DESCRIPTION</b>	<b>DATE</b>	<b>APPROVED</b>
-	Initial release	2/21/24	<i>MDB</i>

**REFERENCE SPECIFICATION**

		<b>MarathonNorco Aerospace, Inc.</b>			
		WACO, TEXAS			
APPROVALS	DATE				
ORIGINATOR Dean Bullock	2/21/2024				
CHECKED		Material Alternates			
APPROVED		SIZE	FSCM	DWG NO	REV
Originating DCR 61272		A	74025	RS-95429	-
				SHEET 1 OF 8	

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## 1.0 SCOPE

This reference specification authorizes the substitution of materials, which are not otherwise authorized by the applicable engineering print. This document is reference only and should not be treated as complete or as a basis for material specification or material temper selection. Parts should be manufactured based on the drawing requirements first and foremost. This document provides guidance for allowable material alternates in situations where raw material per print is not readily available. In cases where the end customer is Rohr, Inc. RPS 20.20 shall be followed. References to the requirements of this specification are listed herein. The majority of this specification is a direct correlation to the RPS 20.20 and RPS 20.50 specifications.

## 2.0 APPLICABLE DOCUMENTS

- 2.1 MMPDS Metallic Materials Properties Development and Standardization.
- 2.2 MIL-HDBK-5H Metallic Materials and Elements for Aerospace Vehicle Structures.
- 2.3 RPS 20.20 Substitution of Materials
- 2.4 RPS 20.50 Substitution of Materials for Goodrich Programs Launched after April 2004

## 3.0 ACRONYMS & ABBREVIATIONS

- 3.1 AISI—American Iron and Steel Institute.
- 3.2 UNS—Unified Numbering System.
- 3.3 ASTM—American Society for Testing Materials.
- 3.4 AMS—Aerospace Materials Specification.
- 3.5 ANSI—American National Standards Institute.
- 3.6 MS—Military Standards.
- 3.7 Mil—Military Specifications.
- 3.8 QQ—Federal Specifications.
- 3.9 WW—Government Procurement Number.

## 4.0 MATERIAL TEMPER

- 4.1 As defined in ANSI H35.1/H/31.1(M)-2009 Alloy and Temper Designation Systems for Aluminum, the T3, T6, etc.. temper designation indicates that the material has been solution heat treated and then artificially aged. Additional digits in the temper designation are used to note additional variations in treatment. These additional digits create designations such as T651, T6510, T6511, T351, T3510, T3511, etc..., which all indicate that the material has been stress relieved. In most cases, these designators satisfy the requirements of the T3, T6, etc... designation. This document list out the approved alternate tempers for these cases.

## 5.0 MATERIAL SUBSTITUTION

- 5.1 Substitutions authorized herein may be made without drawing revision provided that the use of alternate material per this document is noted in the certificate of conformance as “Substitution per RS-95429, and noted on the incoming inspection form (See 5.3 for Rohr specific products).
- 5.2 If product is produced in-house at MNAI, use of alternate material per this reference specification shall be listed on the Manufacturing Order.
- 5.3 End customer requirements flowed down to MNAI shall be followed in determining if this document is applicable or if customer notification or approval is required prior to implementation of alternate materials.
- 5.4 For products where Rohr is the end customer the drawing shall be revised to include “substitution per RS-95429 are allowed”.

- 5.5 Substitutions allowed per this reference specification can be used on a temporary or permanent basis.
- 5.6 The descriptions listed in the Specified Material, Temper & Specification column can refer to the initial or final temper. The descriptions listed in the Substitute Material, Temper & Specification column are the starting conditions. Additional operations or restrictions are listed in the Restricted column.
- 5.7 Interchangeable Items (ITCM) are materials that have similar properties as well as similar fabrication characteristics. Items indicated as ITCM in the tables below may be substituted in reverse order as well (right to left).
- 5.8 Substitutions can be made for substituted materials only if one half of the substitution equation is ITCM. Otherwise this practice, known as “hop scotching”, is prohibited.

## 6.0 ALUMINUM ALLOYS

- 6.1 Material in -T4 and -T42 condition are not interchangeable and shall be substituted only where permitted per the table below.
- 6.2 Material in -T6 and -T62 condition are not interchangeable and shall be substituted only where permitted per the table below One.
- 6.3 When the letter “X” appears in a temper designation it shall designate all variations of the basic temper (e.g., 6061-T651X represents 6061-T6510 or -T6511).

### Aluminum Castings

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
A356.0-T61P AMS 4218	A356.0-T6 AMS-A-21180	Any Class
356.0-T6 AMS 4260	A356.0-T6 AMS-A-21180	Any Class
356-T6 ASTM B108 (PM)	A356.0-T6 AMS-A-21180	Any Class except Class 12
A356.0-T61 ASTM B26 (S)	A356.0-T6 AMS-A-21180	Any Class except Class 11
A35.70-T61 AMS 4219	A357.0-T6 AMS-A-21180	Any Class except Class 10
A356, A356.0, A357.0\ Any temper, any spec.	6061-T6 Plate AMS-QQ-A-250/11	Machine to specified dimension Add “Penetrant Inspect”

### Aluminum Bar – Rolled or Cold Finished

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
2024-O AMS-QQ-A-225/6	2024-F AIR 9051/A	French Specification
2014-T4, -T42 AMS-QQ-A-225/4	2014-T451 AMS-QQ-A-225/4	ITCM for thickness 0.500” through 8.00”
2014-T4, -T451 AMS-QQ-A-225/4	2014-O AMS-QQ-A-225/4	Heat Treat to -T42
2014-T6, -T62 AMS-QQ-A-225/4	2014-T651 AMS-QQ-A-225/4	ITCM for thickness 0.500” through 8.00”
2014-T6, -T651 AMS-QQ-A-225/4	2014-T0 AMS-QQ-A-225/4	Heat Treat to -T62
2014-T6 AMS 4121	2014-T6, -T651 AMS 4029	Limited to thickness 0.040” – 2.500”. Same grain direction.
2014-T6, -T62, -T651 AMS-QQ-A-225/4	2014-T6510, -T6511 AMS-QQ-A-200/2	Limited to 0.751” – 8.00” thick

## Aluminum Bar – Rolled or Cold Finished (continued)

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
2014-T6, -T62 AMS-QQ-A-225/4	2024-T351 AMS-QQ-A-225/6	Age to T-851
2024-T351 AMS-QQ-A-225/6	2024-T6 AMS-QQ-A-225/6	Not recommended for machining applications. Distortion may result
2024-T351 AMS 4119	2024-T351 AMS-QQ-A-225/6	Limited to rectangular cross sections up to 4.00" and circular cross sections up to 6.500"
2024-T351 AMS-QQ-A-225/6	2024-T35XX AMS-QQ-A-200/3	Limited to thickness over 0.750"
2024-T4, -T42 AMS-QQ-A-225/6	2024-T351 AMS-QQ-A-225/6	Limited to thickness 0.500" – 6.500"
2024-T6 AMS-QQ-A-225/6	2024-T851 AMS-QQ-A-225/6	
2024-T851 AMS-QQ-A-225/6	2024-T85XX AMS-QQ-A-200/3	Limited to thickness over 0.750"
6061-T4, -T42 AMS-QQ-A-225/8	6061-T451 AMS-QQ-A-225/8	Limited to thickness 0.500" – 8.00"
6061-T6, -T62 AMS-QQ-A-225/8	6061-T651 AMS-QQ-A-225/8	Limited to thickness 0.500" – 8.00"
6061-T6, -T651 AMS-QQ-A-225/8	6061-O AMS-QQ-A-225/8	Heat treat to -T62. Not recommended for machining applications. Distortion may result
6061-T6, -T651 AMS 4117	6061-T6, -T651 AMS-QQ-A-225/8	ITCM
6061-T4, -T451X AMS-QQ-A-200/8	6061-T4, -T42, -T451 AMS-QQ-A-225/8	
7075-T6, -T62 AMS-QQ-A-225/9	7075-T651 AMS-QQ-A-225/9	ITCM for thickness up to 4.00"
7075-T6 AMS 4122	7075-T6, -T651 AMS-QQ-A-225/9	ITCM
7075-T6, -T62, -T651 AMS-QQ-A-225/9	7075-T6, -T651X AMS-QQ-A-200/11	Limited to thickness up to 4.499". Not recommended for machining. Distortion may result.
7075-T73 AMS-QQ-A-225/9	7075-T7351 AMS-QQ-A-200/11	ITCM for thickness 0.500" through 3.00"
7075-T73 AMS-QQ-A-225/9	7075-T7351 AMS-QQ-A-225/9	ITCM for thickness 0.500" through 3.00"
7075-T73 AMS-QQ-A-225/9	7075-T651 AMS-QQ-A-225/9	Age to -T7351. Limited to thickness up to 3.00"
7075-T73 AMS-QQ-A-225/9	7075-T651 AMS-QQ-A-225/9	Age to -T7351. Limited to thickness up to 3.00"
7075-T7351 AMS-QQ-A-225/9	7075-T7351 AMS-QQ-A-200/11	Limited to thickness up to 3.00"

## Aluminum Extrusions – Bar, Rod and Shapes

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
2014-T4 AMS-QQ-A-200/2	2014-T451X AMS-QQ-A-200/2	
2014-T42 AMS-QQ-A-200/2	2014-T4, -T451X AMS-QQ-A-200/2	
2014-T42 AMS-QQ-A-200/2	2014-T4 AMS-QQ-A-225/4	

## Aluminum Extrusions – Bar, Rod and Shapes (continued)

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
2014-T42 AMS-QQ-A-200/2	2014-O AMS-QQ-A-225/4	Heat treat to -T42
2014-T6 AMS-QQ-A-200/2	2014-T651X AMS-QQ-A-200/2	
2014-T62 AMS-QQ-A-200/2	2014-T6, -T651X AMS-QQ-A-200/2	
2014-T6, -T651X AMS-QQ-A-200/2	2014-O AMS-QQ-A-200/2	Limited to thickness up to 0.499". Heat treat to -T62. Not recommended for machining applications when -T651X temper is specified. Distortion may result.
2024-T42 AMS-QQ-A-200/3	2024-T351X AMS-QQ-A-200/3	
2024-T42 AMS-QQ-A-200/3	2024-T4 AMS-QQ-A-225/6	
2024-T42 AMS-QQ-A-200/3	2014-O AMS-QQ-A-225/6	Heat treat to -T42. Limited to thickness up to 6.500"
2024-T81 AMS-QQ-A-200/3	2024-T851X AMS-QQ-A-200/3	
2024-T8510 AMS-QQ-A-200/3	2024-T351X AMS-QQ-A-200/3	Age to -T851X
2024-T8510 AMS-QQ-A-200/3	2024-T851 AMS-QQ-A-225/6	Same grain direction
2024-T8510 AMS-QQ-A-200/3	2024-T351 AMS-QQ-A-225/6	Age to -T851X. Same grain direction.
2024-T8511 AMS-QQ-A-200/3	2024-T3511 AMS-QQ-A-200/3	Age to -T8511
2024-T8511 AMS-QQ-A-200/3	2024-T851 AMS-QQ-A-225/6	Same grain direction
2024-T8511 AMS-QQ-A-200/3	2024-T351 AMS-QQ-A-225/6	Age to -T851. Same grain direction
6061-any temper AMS-QQ-A-200/8	6061-same temper AMS-QQ-A-225/8	Heat treat per drawing requirements
6061-O AMS 4160	6061-O AMS-QQ-A-200/8	ITCM
6061-T4 AMS 4161	6061-T4 AMS-QQ-A-200/8	ITCM
6061-T4 AMS 4150	6061-T451X AMS-QQ-A-200/8	
6061-T42 AMS-QQ-A-200/8	6061-T451X AMS-QQ-A-200/8	
6061-T451X AMS-QQ-A-200/8	6061-O AMS-QQ-A-200/8	Heat treat to -T42. Not recommended for machining applications. Distortion may result
6061-T6 AMS 4150	6061-T6 AMS-QQ-A-200/8	
6061-T6 AMS 4150	6061-T651X AMS-QQ-A-200/8	
6061-T6, -T62 AMS-QQ-A-200/8	6061-any temper AMS-QQ-A-200/8	Heat treat to -T62
6061-T62 AMS-QQ-A-200/8	6061-T651X AMS-QQ-A-200/8	

## Aluminum Extrusions – Bar, Rod and Shapes (continued)

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
6016-T651X AMS-QQ-A-200/8	6061-O AMS-QQ-A-200/8	Heat treat to -T62. Not recommended for machining applications. Distortion may result
7075-T6, -T62 AMS-QQ-A-200/11	7075-T651X AMS-QQ-A-200/11	
7075-T6511 AMS-QQ-A-200/11	7075-any temper AMS-QQ-A-200/11	Heat treat to -T62. Not recommended for machining applications. Distortion may result
7075-T73 AMS-QQ-A-200/11	7075-O AMS-QQ-A-200/11	Heat treat to -T73
7075-T73510 AMS-QQ-A-200/11	7075-T6510 AMS-QQ-A-200/11	Age to -T73
7075-T73510 AMS-QQ-A-200/11	7075-T6510 AMS-QQ-A-200/11	Age to -T73510
7075-T73510 AMS-QQ-A-200/11	7075-T651X AMS-QQ-A-200/11	Age to -T7351X

## Aluminum Drawn Tubing

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
2024-T81 AMS-WW-T-700/3	2024-T851 AMS 4339 2024-T851 AMS-QQ-A-225/6	
2024-T3 AMS-WW-T-700/3	2024-T851 AMS 4339 2024-T851 AMS-QQ-A-225/6	
2024-T42 AMS-WW-T-700/3	2024-T3 AMS-WW-T-700/3	
2024-T42 AMS-WW-T-700/3	2024-T851 AMS 4339 2024-T851 AMS-QQ-A-225/6	
6061-T4, -T42 AMS-WW-T-700/6	6061-T4, -T42, -T451 AMS-QQ-A-225/8	
6061-T4, -T42 AMS-WW-T-700/6	6061-T6 AMS-WW-T-700/6	
6061-T4, -T42 AMS-WW-T-700/6	6061-T62 AMS-WW-T-700/6	For thickness range between 0.025”-0.500”
6061-T6, -T62 AMS-WW-T-700/6	No known substitute available	

## Steel Bar

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
4130 MIL-S-6758	8630 AMS 6280	ITCM. Same heat treat condition
4130 MIL-S-6758	4130 AMS 6348	ITCM
4130 Condition F (Hardened and Tempered) MIL-S-6758	4130 Condition D (Normalized) MIL-S-6758	Heat treat to 125-145 ksi
4140 MIL-S-5626 or AMS 6382	8740 MIL-S-6049	ITCM
4330M AMS 6427	4330M AMS 6411	
E4340 MIL-S-5000	4340 AMS 6415	

## Steel Bar (continued)

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
E4340 MIL-S-5000	4340 AMS 6414	
4340 AMS 6415	4340 AMS 6414	
4620 MIL-S-7493	8620 MIL-S-8690 or AMS 6294	
9310 AMS 6260	9310 AMS 6265	

## Steel Tubing

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
4130 MIL-T-6736	4130 AMS 6360	ITCM
4130 AMS 6360	8630 AMS 6281	ITCM

## Corrosion Resistant Steel Castings

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
17-4 PH AMS 5342 (130 ksi) or 15-5 PH AMS 5356 (130 ksi)	15-5 PH AMS 5659	Machine to same dimension and precipitation harden to Condition H1025
17-4 PH AMS 5343 (150 ksi) or 15-5 PH AMS 5347 (150 ksi)	15-5 PH AMS 5659	Machine to same dimension and precipitation harden to Condition H1025
17-4 PH AMS 5344 (180 ksi) or 15-5 PH AMS 5356 (180 ksi)	15-5 PH AMS 5659	Machine to same dimension and precipitation harden to Condition H900
17-4 PH AMS 5344 (180 ksi)	15-5 PH AMS 5346	
17-4 PH AMS 5343 (150 ksi)	15-5 PH AMS 5347	
17-4 PH AMS 5355	15-5 PH AMS 5659	Machine to same dimensions and precipitation harden to the same heat treat condition as noted on the engineering drawing. Add "Magnetic Inspect per RPS 18.08." Delete Casting NDT.

## Corrosion Resistant Steel Bar

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
302 MIL-S-7720	302 QQ-S-763	Condition A Material
302 QQ-S-763	304 QQ-S-763	Condition A Material
304 AMS 5639	304 QQ-S-763	Condition A Material
321 QQ-S-763	321 AMS 5645	ITCM
347 QQ-S-763	347 AMS 5646	ITCM



## Corrosion Resistant Steel Bar (continued)

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
321 QQ-S-763	347 QQ-S-763	ITCM
440C QQ-S-763	440C AMS 5630	ITCM
422 AMS 5655	15-5 PH AMS 5659	Precipitation harden to Condition H1100
15-5 PH AMS 5659	15-5 PH AMS 5862	Same grain direction
17-4 PH AMS 5643	15-5 PH AMS 5659	

## Corrosion Resistant Steel Tubing

Specified Material, Temper & Specification	Substitute Material, Temper & Specification	Restriction
304 MIL-T-8504 Type I	304 AMS 5567 Type I or 321 AMS 5557 Type I or 347 AMS 5556 Type I	
304 MIL-T-8504 Type II	321 AMS 5557 Type II or 347 AMS 5556 Type II	
304L AMS 5566 Type I	304L AMS-T-6845 Type I or 304L AMS 5564 Type I	Tubing must be the same OD and wall thickness
321 MIL-T-8606	321 AMS 5557 or 347 AMS 5556	
321 AMS 5557	347 AMS 5556	
321 MIL-T-8808 Type II	321 AMS 5557 Type II or 347 AMS 5556 Type II	
321 MIL-T-8808	321 AMS 5557	
321 MIL-T-8808 Type II or 347 MIL-T-8808 Type II	21-6-9 AMS 5562	Less formability than 321 or 347
347 MIL-T-8606	347 AMS 5556	
347 MIL-T-8808	347 AMS 5556	
21-6-9 AMS 5562	21-6-9 RMS 179	