

**AIPS****Airbus Process Specification****Installation of Solid Rivets**

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## Contents

- 1 Scope
- 2 Normative References
- 3 Definition, Applicability and Limitations
- 4 Engineering Requirements
- 5 Technical Qualification
- 6 Rework
- 7 Environment, Health and Safety
- Annex A (normative)

## 1 Scope

This Airbus Process Specification defines the Engineering requirements for Installation of Solid Rivets.

This specification does not give detailed instructions; these are given in the Process Instructions (PI) / Airbus Process Instruction (AIP) and the Work Instructions.

This specification shall not be used as an inspection document.

It shall be applied when mentioned in the relevant standard, material specification or Definition Dossier.

## 2 Normative References

Only normative references cited in the text are listed hereafter.

The latest issue of the publication referenced shall be used.

A1091	Airbus Requirements for the Management of Hazardous Substances
ABS0056	Aerospace series. Rivet, countersunk
ABS1771	Aerospace series, Rework and Repair of Holes and Fasteners
AITM10070	Surface Roughness Measurements Using Surface Contact Stylus Method
AIPS01-02-003	Preparation of Holes in Metallic Materials for Fastening
AIPS01-02-005	Preparation of Holes in in Fibre Reinforced Plastic (FRP) and Mixed (FRP/Metal) Assemblies for Fastening
AIPS01-02-012	Machining and Assembly of Glare (R) Parts/Components
AIPS01-02-017	General Assembly and Installation of Fasteners
AIPS03-11-001	Machining of Metallics
AIPS04-01-002	Heat Treatment of Solid Rivets
AIPS05-02-011	Rework of paints on metallic and non metallic structural parts
AIPS05-05-001	Sealing of Aircraft Structures Inside and Outside Fuel Tank
AIPS05-05-004	Wet Installation of Fasteners
EN6069	Aerospace series Rivet, 100° reduced flush head, close tolerance, inch series
EN6080	Aerospace series Rivet, normal flush head, close tolerance, inch series
EN6081	Aerospace series Rivet, universal head, close tolerance, inch series
EN6101	Aerospace series Rivet, 100° medium flush head, close tolerance, inch series
EN9103	Quality management systems - Variation management of key characteristics

## 3 Definition, Applicability and Limitations

### 3.1 Definition

EMR	Electro magnetic riveting. Forming the upset tail of the solid rivet by an ultrafast single blow.
Installed as received	Solid rivets being installed as shipped from the manufacturer, without further heat treatment.
Allowance	Additional material on the shank side being formed to a flat or countersunk upset tail.
Grip	Total thickness of components in the stack-up.
Solid rivet length	For universal head solid rivets the shank length and for solid rivets with countersunk heads the shank length inclusive the height of the countersunk head.
Protrusion	Countersunk head surface being above sheet surface.
Indentation	Countersunk head surface being under sheet surface.
Riveting	Forming the solid rivet by squeezing or hitting.
Direct riveting	Installation of solid rivets while the rivet gun is located on the upset tail side.
Indirect riveting	The rivet gun is located on the solid rivet's head side.
Upset tail	Flattened shank end formed by hitting or squeezing.

Delamination	Separation of bonded fibres from the basic material.
Faying surface	Surface between two joined materials.
Stack-up	Combination of materials to be fastened.
FRP	Fiber Reinforced Plastic including CFRP.
CFRP	Carbon Fiber Reinforced Plastic.
FML	Fiber Metal Laminate (GLARE®).
Solid shank rivet	Rivet with continuous solid shank.
Hollow end rivet	Rivet with a cavity at the shank end.
Preformed head	Rivet head formed at the rivet manufacturer.

### 3.2 Applicability

This Airbus specification is applicable when invoked by the drawing directly or through another document for the purpose given in the scope. When processing to AIPS01-01-004 is required, it shall be invoked on the drawing by the words "Installation of Solid Rivets according to AIPS01-01-004". Process instructions shall not be called on drawing.

This Airbus Process Specification covers the requirements for the installation of solid rivets with a solid shank made from aluminum, aluminum alloys, titanium niobium (44.5Cb) and nickel-copper alloy (Monel NiCu31) with a preformed head. The solid rivets are to be installed manually or by automatic riveting machines using a multi-stroke rivet gun, EMR rivet tool or squeeze. Also covered are solid rivets with a hollow shank end which are made from titanium (T40) or titanium niobium (44.5 Cb). These solid rivets are installed manually by squeezing. Solid rivets are used for joining components of aluminum alloy, titanium alloy, CRES, FML and FRP.

AIPS01-01-004 is applicable for the final assembly line of A400M, the program A350 and subsequent AIRBUS programs and when it is invoked in the drawings of other Airbus programs. The solid rivets being installed to this specification are per following standards:

- ABS0056, style A and B
- EN6069
- EN6080
- EN6081
- EN6101

### 3.3 Limitations of the process

The process shall not be applied to solid rivets and component materials other than specified in 3.2.

The size and shape of installation equipment may limit the applications of solid rivets. Inaccessible applications shall always be referred to the relevant Design Authority.

Installation of solid rivets by using a hand hammer is only applicable for rivets from aluminum 1050A-H14.

Single stroke riveting except EMR rivet process shall not be used for solid rivets.

Universal head solid rivets shall not be riveted using a flat die at the universal head side.

Solid shank rivets shall not be used in parts having a low elongation (example: castings or compression molded parts) or which are prone to stress corrosion (example: ST-direction of plate from 2024-T3 or -T351, 7075-T6) and in injection molded brackets with and without fiber reinforcement.

The minimum metallic sheet thickness on the upset tail side shall meet the values of Table 1, if not otherwise specified on the drawing.

Nickel-copper alloy (Monel) solid rivets shall only be used in high temperature applications up to an operating temperature of 427°C.

**Table 1: Minimum sheet thickness on the upset tail side for flat and tapered upset tails**

Nominal solid rivet diameter $d_1$	Solid rivet material		
	Al-alloy <sup>1)</sup>	Titanium 44.5Cb <sup>1), 2)</sup>	Nickel-copper (Monel) <sup>2)</sup>
	$t_{min}$	$t_{min}$	$t_{min}$
1,6	-	-	0,8
2,4	0,8	0,8	0,8
3,2	1,0	1,0	1,2
3,6	1,2	1,2	1,4
4,0	1,4	1,4	1,6
4,4	1,4	1,4	1,6
4,8	1,8	1,8	2,0
5,6	2,3	2,3	2,4

<sup>1)</sup> Al-alloy part on the upset tail side

<sup>2)</sup> Steel, titanium, Inconel etc. on the upset tail side

For joining FRP riveting of solid shank rivets shall only be performed by squeezing or EMR.

Aluminum solid rivets shall not be used in CFRP or in stack-ups containing CFRP.

Rivets per ABS0056 with hollow shank end shall only installed by squeezing using appropriate tooling. Hollow end rivets per ABS0056 feature no shank expansion when squeezing the countersunk upset tail. ABS0056-B (style B) rivets shall be used for joints with FRP material on the upset tail side, ABS0056-A (style A) rivets are designed for metallic applications, only.

The countersunk upset tail of a solid shank rivet shall not be located in a FRP sheet.

## 4 Engineering Requirements

Engineering requirements are minimum requirements specified by Responsible Engineering to ensure optimal performance of the manufacturing process.

All Engineering requirements have to be met and controlled in production.

### 4.1 Performance Requirements

All dimensions in this AIPS are given in millimeter (mm). Any specific indication of the engineering drawing shall prevail over the requirements indicated in this specification.

#### 4.1.1 Holes/countersinks

##### 4.1.1.1 Hole and countersink requirements

Hole and countersink preparation shall be performed to AIPS01-02-003 for metallic structure, to AIPS01-02-005 for FRP and hybrid structure and to AIPS01-02-012 for FML structure.

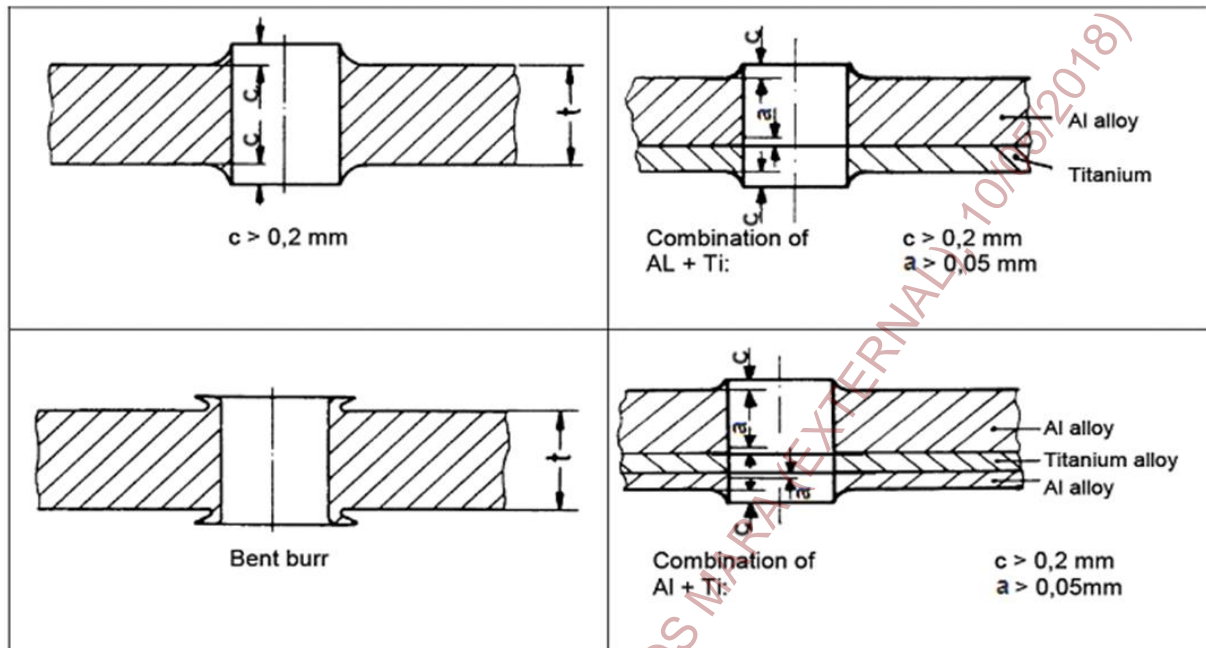
Solid rivet hole diameters shall meet the requirements defined in Table 2, if not otherwise specified on the drawing.

**Table 2: Hole diameters for solid rivets from Aluminum, Aluminum alloy, Titanium Niobium (44.5Cb), Titanium (T40) and Nickel-copper (Monel NiCu31)**

Nominal solid rivet diameter $d_1$	Aluminum and aluminum alloy solid rivets: EN6069 EN6080 EN6081 EN6101		44.5Cb solid rivets: EN6069 EN6080 EN6081 EN6101
	Applicable for riveting by EMR and riveting by solid rivet gun and squeeze	Applicable for automatic riveting by squeezing	T40/44.5Cb hollow shank solid rivets: ABS0056 <sup>1)</sup>  Nickel-copper (Monel NiCu31) solid rivets: EN6069 EN6080 EN6081 EN6101
1,6	1,620 – 1,720	–	–
2,4	2,420 – 2,520	2,420 – 2,495	2,460 – 2,560
2,8	2,820 – 2,920	–	2,850 – 2,950
3,2	3,220 – 3,320	3,220 – 3,295	3,250 – 3,350
3,6	3,620 – 3,720	–	3,650 – 3,750
4,0	4,010 – 4,110	4,010 – 4,085	4,050 – 4,150
4,4	4,410 – 4,510	–	4,450 – 4,550
4,8	4,800 – 4,900	4,800 – 4,875	4,850 – 4,950
5,2	5,200 – 5,300	–	5,250 – 5,350
5,6	5,600 – 5,700	5,600 – 5,675	5,650 – 5,750
6,0	6,000 – 6,100	–	–
6,4	6,400 – 6,500	6,400 – 6,475	–
7,2	–	7,180 – 7,255	–
8,0	–	7,970 – 8,045	–
9,6	–	9,570 – 9,645	–

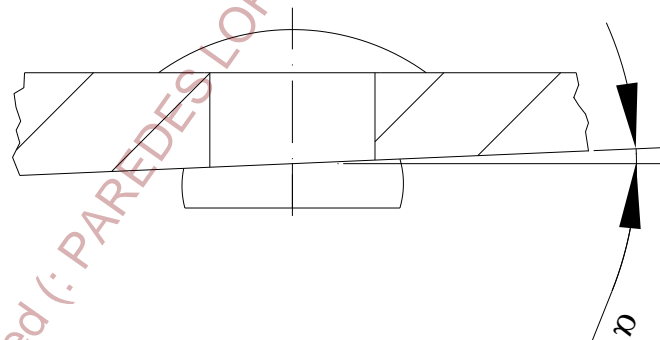
<sup>1)</sup> No ABS0056 oversize solid rivets are available

The burr height in metallic sheets shall be in accordance with Figure 1. Deburring of holes is required if the burr height exceeds the given values or if components are removed after drilling, e. g. to apply sealant unless stated otherwise on the drawing. Chamfering of holes between two sheets due to excessive deburring is not permissible.



**Figure1: Not permissible burrs for metallic materials**

The maximum back side slope for installation of Al and Monel solid rivets is shown in Figure 2 and Table 3.

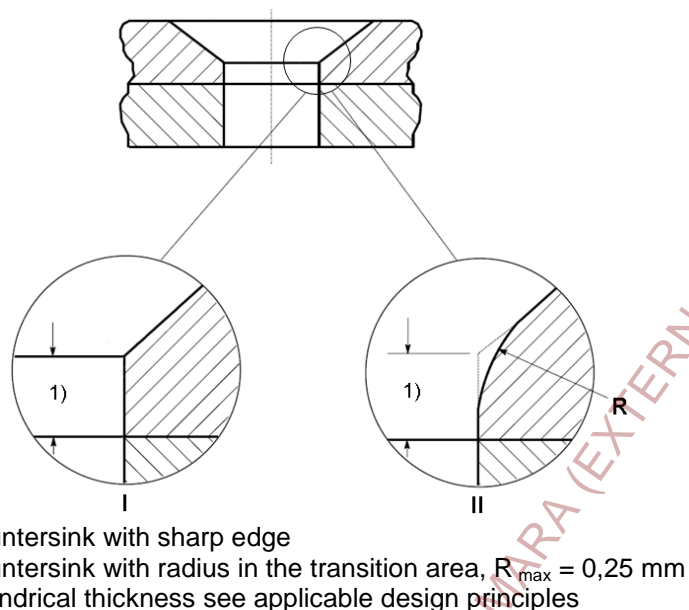


**Figure 2: Upset tail on non-parallel surface, sloped back side**

**Table 3: Maximum permissible back side slope, solid shank rivets**

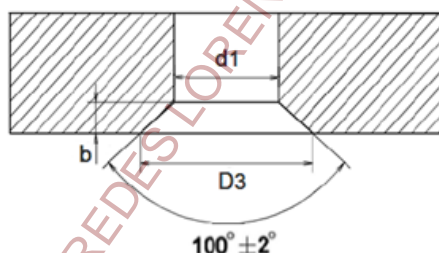
Rivet Material	Max. slope for dia.						
	≤ 3,2	4,0	4,8	5,6	6,4	7,9	≥ 9,6
Al-alloy, 44.5Cb	7°				3°		
Monel	3°				No application		

In countersunk holes the min. remaining cylindrical part of the countersunk sheet shall meet the requirements of the applicable design principles. It is measured to the edge inside the hole, respectively on chamfered/radiused holes to the point where the tangents of hole and countersunk meet each other, see Figure 3. The transition area between countersink and cylindrical part of the hole may have a sharp edge or a radius "R".



**Figure 3: Countersink and sheet thickness requirements for metallic structure**

The upset tail sided countersink diameter for ABS0056 hollow end rivets in metallic or FRP sheet shall be as defined in Figure 4 and Table 4. Fastener hole and countersink on upset tail side shall be perpendicular within  $\pm 2^\circ$ .



**Figure 4: ABS0056 countersink dimensions**

**Table 4: ABS0056 countersink requirements**

Dimension		Type	Diameter code							
			-4		-5		-6		-7	
Nominal solid rivet diameter	$d_1$	A, B	3,2		4		4,8		5,6	
Countersunk depth (ref.)	b	A	0,7		0,9		1,2		1,2	
		B	0,7		0,9		1,2		1,4	
Countersink diameter	$D_3$		min	max	min	max	min	max	min	max
		A	4,80	4,95	6,15	6,27	7,54	7,67	8,20	8,33
		B	4,80	4,95	6,05	6,20	7,45	7,60	8,90	9,05

The transition area between countersink and cylindrical hole on the upset tail side shall have a sharp edge independently of the applied rivet type and material.

#### 4.1.1.2 Surface finish

The surface finish of holes and countersinks shall meet the requirements in AIPS01-02-005 for FRP and hybrid structure and AIPS01-02-012 for FML structure. The surface of holes and countersinks in metallic material should



not be protected (anodized) and shall exhibit an average surface finish of  $R_a \leq 3,2 \mu\text{m}$ . Measurements shall be performed in accordance with AITM1-0070.

#### 4.1.2 Solid rivet length

For joining a stack-up of sheets the length of solid shank solid rivets is calculated according to the part thickness plus an allowance according to chapter 4.1.2.1 and 4.1.2.2 to form the upset tail.

For solid rivets per ABS0056, grip ranges are given in the rivet standard.

On sloped surfaces the grip of a stack-up is measured at the hole at the position of the smallest thickness.

##### 4.1.2.1 Flat or tapered upset tail of solid shank rivet

If solid rivets are installed with a flat or tapered upset tail (Figure 5) the solid rivet length shall be determined to the formulas listed in Table 5.

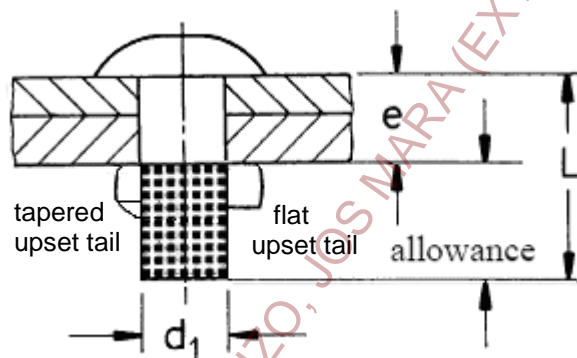


Figure 5: Allowance for a flat or tapered upset tail

Table 5: Determination of solid rivet length for a flat or tapered upset tail

Solid rivet material	Calculation of theoretic solid rivet length	Conversion from calculated length L to the length per rivet standard
Al and al-alloys	$L = e + 1,3 \times d_1$	L has to be rounded to the next higher or lower length per applicable solid rivet standard, whichever is closer to the calculated value.
Titanium niobium (44.5Cb)	$L = e + 1,25 \times d_1$	
Nickel-copper alloy (Monel NiCu31)	$L = e + 0,8 \times d_1$ For installation in steel, titanium, inconel etc.	L has to be rounded to the next higher length per applicable solid rivet standard

##### 4.1.2.2 Countersunk upset tail of solid shank rivet

The installation of solid rivets with a 100° countersunk upset tail is only applicable for solid rivets made from aluminum, aluminum alloys and titanium niobium 44.5Cb.

The solid rivet length "L" for countersunk upset tails per Figure 6 and Table 6 is calculated as follows:

$$L = e + 0,7 \times d_1 \text{ to } e + 1,3 \times d_1.$$

Figure 6 and Table 6 contain requirements for 100° countersink upset tails of solid shank solid rivets in metallic material except for Nickel-copper (Monel NiCu31) solid rivets.

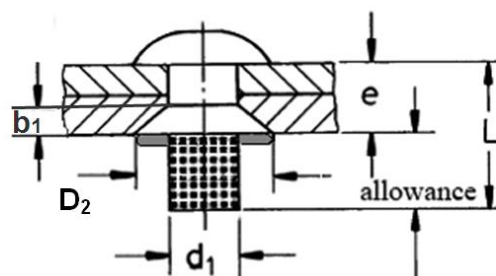


Figure 6: Allowance for 100°- countersunk upset tails of solid shank solid rivets

Table 6: Dimensions for 100°- countersink solid shank solid rivets in metallic material [not applicable to Nickel-copper rivets (Monel NiCu31)]

Diameter code	-3	-4	-5	-6
Nominal solid rivet diameter $d_1$	2,4	3,2	4,0	4,8
Countersunk depth (ref.) $b_1$	0,7	0,9	1,1	1,4
Countersink diameter $D_2$	4,0	5,2	6,5	8,0
	4,1	5,3	6,6	8,1

The calculation factor is determined to achieve optimal filling of the countersunk and can vary depending of solid rivet material and riveting process. The length L thus obtained has to be rounded to the next higher or lower length per applicable solid rivet standard whichever is closer to the calculated value.

#### 4.1.2.3 Cutting solid rivets to length

If the required solid rivet length is not available it is acceptable to shorten the solid rivet shank. Solid rivets from aluminum and aluminum alloy can be cut by shear cutting. Solid rivets from titanium niobium (44.5Cb) and nickel-copper alloy (Monel NiCu31) shall not be shortened by shear cutting, but only by sawing or milling. IVD plated solid rivets shall not be shortened. The obtained length shall be inside the length range of the relevant solid rivet standard. The cut shall be at 90° to the shank axis. The solid rivet shall have a plane shank end or a chamfer or radius as requested by the standard. Burrs have to be removed by filing. The grinding of solid rivets to length is forbidden for all materials.

Solid rivets per ABS0056 shall not be cut to length.

#### 4.1.3 Assembly/Clamping/Sealant application

Parts shall be assembled and clamped to the general assembly requirements of AIPS01-02-017.

Interfay sealant shall be applied to the requirements of AIPS05-05-001 if applicable.

Wet installation of solid rivets shall be performed as per AIPS05-05-004 if applicable.

#### 4.1.4 Riveting

Only solid rivets called up on the drawing shall be used.

Solid rivets from al-alloy 2017A-T4 can be installed in the as received or in the solution heat treated condition. Heat treatment shall be performed to AIPS04-01-002.

When solid rivets are squeezed the upset tail shall be formed in a single continuous action.

If nickel-copper alloy (Monel) solid rivets are installed by a solid rivet gun, direct riveting is the preferred method.

When riveting FRP with solid shank rivets, the upset tail side shall be installed on a metallic part or metallic washer with minimal thickness to Table 1 to exclude delamination or any kind of deformation or damage of the FRP material. Installation of ABS0056-B hollow end solid rivets into FRP shall be performed with verified installation force or clamping limit to ensure damage free material condition after installation.

Upset tail dimensions for solid rivets according to Figure 7, shall meet the requirements of Table 7 and Table 8. Dimensions are applicable to flat and tapered upset tails.

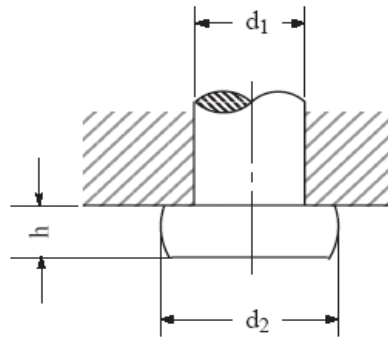


Figure 7: Upset tail dimensions

Table 7: Upset tail dimensions for solid rivets from aluminum, aluminum alloy and titanium niobium (44.5Cb)

Diameter Code	Nominal solid rivet diameter $d_1$	$d_2$		$h$	
		min	max	min	max
-2	1,6	2,3	3,3	0,6	1,1
-3	2,4	3,6	4,8	0,8	1,4
3X	2,8				
-4	3,2	5,0	6,0	1,1	1,8
-4X	3,6				
-5	4,0	6,2	7,5	1,3	2,3
-5X	4,4				
-6	4,8	7,3	8,7	1,5	2,5
-6X	5,2				
-7	5,6	8,5	10,0	1,7	3,1
-7X	6,0				
-8	6,4	9,5	11,0	1,9	3,5
-10	8,0	11,8	13,5	2,6	4,4
-12	9,6	14,0	16,0	3,2	5,2

Table 8: Upset tail dimensions for solid rivets from Nickel-copper (Monel NiCu31)

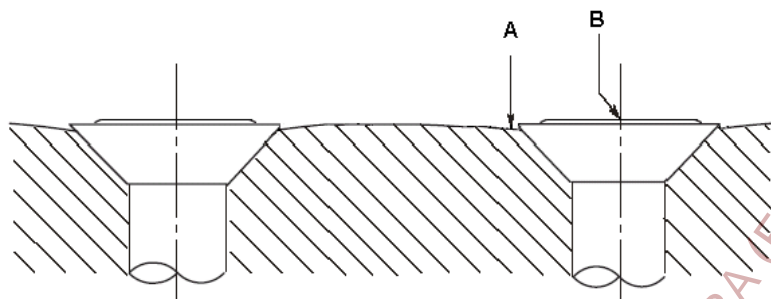
Diameter Code	Nominal solid rivet diameter $d_1$	$d_2$		$h$	
		min	max	min	max
-3	2,4	3,2	3,6	0,65	0,90
3X	2,8	3,7	4,2	0,75	1,10
-4	3,2	4,3	4,8	0,85	1,25
-4X	3,6	4,8	5,4	0,95	1,50
-5	4,0	5,3	5,9	1,10	1,70
-5X	4,4	5,8	6,5	1,20	1,85
-6	4,8	6,4	7,1	1,30	2,00
-7	5,6	7,4	8,2	1,50	2,30

No cracks are allowed on preformed heads of solid rivets. Waviness and gaps in the faying surface at joints have to be in accordance with AIPS01-02-017. Requirements for installed solid rivets and surface integrity of assemblies are defined in Tables A.1 to A.3 in the annex.

Bare surfaces of installed solid rivets resulting from milling, sawing or shear cutting have to be protected by touch-ups as per AIPS05-02-011 after quality check of the installed rivet.

The countersink preparation shall assure that after riveting the countersunk head meets the requirements of Figure 8 and Table 9 in terms of min. countersunk head protrusion. The max. protrusion has to be in accordance with relevant requirements.

Measurement of the countersunk head protrusion of the preformed head has to be performed according to Figure 8.



A: reference point on component surface, adjacent to solid rivet head  
B: measurement point on the manufactured head

**Figure 8: Positions to determine countersunk head protrusion after installation**

**Table 9: Countersunk head protrusion after riveting (except ABS0056)**

Solid rivet material	Minimal countersunk head protrusion after riveting
Aluminum and Aluminum alloy, solid rivets installed as received	+ 0,05
Solid rivets from aluminum alloy 2017A-T4, installed in solution heat treated condition <sup>1)</sup>	
Titanium niobium (44.5Cb) and Nickel-copper (Monel NiCu31)	+ 0,01

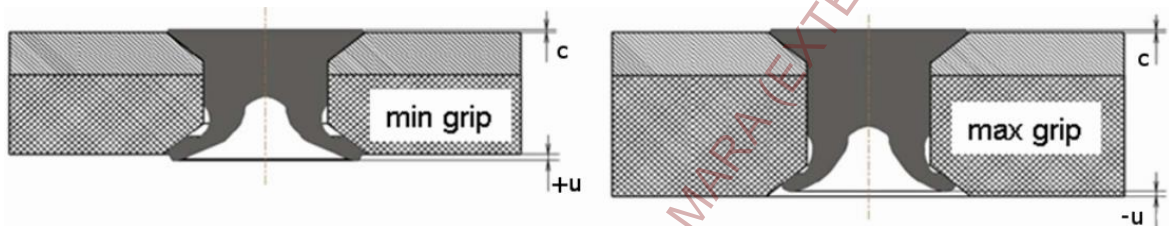
<sup>1)</sup> Solution heat treatment of solid rivets from material 2017A-T4 as per AIPS04-01-002

If the countersunk head of 100° medium flush head solid rivets made from aluminum or aluminum alloy exceeds the max protrusion specified on the drawing, 5% of the countersunk head height are allowed to be milled off to meet flushness requirements. Up to 10% may be milled off in case of normal flush head aluminum or aluminum alloy solid rivets. On domed countersunk rivets the dome height shall not be considered in the calculation. In case of milling countersunk heads, requirements of AIPS03-11-001 are to be met. Grinding shall not be applied. If repair solid rivets, solid rivets with a 100° reduced flush head or solid rivets per ABS0056 are applied, milling of the manufactured countersunk head is not allowed.

The countersunk upset tail after riveting has to fill the countersunk completely. Excessive material can be milled off per AIPS03-11-001 when flushness limits are not met. Grinding shall not be used. Countersunk head limits for solid rivets per ABS0056 are given in Table 10 and Figure 9. Milling of countersunk upset tails of hollow end solid rivets per ABS0056 is not allowed.

**Table 10: Countersunk head protrusion/indentation of ABS0056 after riveting**

Type	c		u	
	min	max	min	max
A	0,00	+0,13	0,00	+0,38
B	0,00	+0,10	-0,25	+0,25



**Figure 9: Countersunk head protrusion/indentation of ABS0056 after riveting**

#### **Assembly with anchor nuts only:**

In the application with the assembly of anchor nuts (only) a protrusion of solid rivets is not always possible (against table 9).

For example when the anchor nuts are used to ensure clearance of the parts on the side of the rivet head the countersunk head of the solid rivet shall be after installation between 0,00 mm and -0,3 mm.

Note: the minimal flushness can never exceed 10% of sheet thickness under solid rivet head. E.g. sheet iron of 1,6mm > flushness tolerated: 0 / -0,16mm.

However it shall be ensured that only specific dies will be used that are having a diameter smaller than the rivet head diameter itself and it shall be ensured that the surrounding surface won't be damaged or scratched."

## **4.2 Other Requirements**

### **4.2.1 Personnel**

All personnel shall be suitably trained to carry out the process of installing solid rivets.

### **4.2.2 Process**

All processes shall be qualified in accordance with section 5.

Installation processes shall be controlled within the limitations of this specification and parts/assemblies inspected to ensure they meet the requirements shown in section 4.1.

On automatic riveting machines a periodical quality check has to be done by riveting a control specimen to verify that the requirements of this AIPS will be met. The specimen to be used and the frequency of tests have to be defined in the local process specification.

Controls shall be in place to ensure oversize repairs are carried out under non-conformance documentation as agreed by the Airbus Quality Assurance Authority.

### **4.2.3 Approved materials / solid rivets**

All materials used during installation and the solid rivets shall be qualified and shall be obtained from Airbus approved sources.

### **4.2.4 Tooling/Equipment**

All tooling and equipment shall be obtained from controlled sources and shall be certified as suitable for intended use and conforming to the requirements of this specification.

The calibration frequency of setting tools and calibration equipment shall be sufficient to suit the tooling usage and environment as required by the Quality Assurance Authority

### **4.2.5 Manufacturing shop**

The manufacturing shop shall be approved to the requirements of the Airbus Quality Assurance function for the production and supply of parts assembled to this process.

## **4.3 Key Characteristics**

Key Characteristics acc. to EN9103 are defined by responsible engineering based on a risk analysis for parts manufactured by this process. Key characteristics shall be defined on product level and if necessary also on process level.

They shall be subject to variation control by production organization according to EN9103.

Key Characteristics do not relieve the production organization from meeting all engineering requirements defined in this document.

Table 11: Key Characteristics

Product Key Characteristics			Process Key Characteristics		
No.	Designation	Requirements/ Limits (sub-clause)	Sub.- No.	Designation	Requirement/ Limit
1	<b>Holes and countersinks</b> - preparation  - dimensions: hole, countersunk transition countersink diameter countersink perpendicularity countersink angle - surface finish	- 4.1.1.1: in metal: AIPS01-02-003 in FRP: AIPS01-02-005 in FML: AIPS01-02-012  - 4.1.1.1   - 4.1.1.2: in metal: 3,2 µm in FRP: AIPS01-02-005 in FML: AIPS01-02-012	Shall be defined in relevant AIP		
2	<b>Fasteners</b> - rivet length: flat or tapered upset tail countersunk upset tail	- 4.1.2 4.1.2.1 4.1.2.2			
3	<b>Sealant application</b> - interfay sealant - wet installation	- 4.1.3: AIPS05-05-001 - 4.1.3: AIPS05-05-004			
4	<b>Installation</b> - clamping - squeezing - riveting in FRP	- 4.1.3: AIPS01-02-017 - 4.1.4 single cont. action - 4.1.4 washer/metallic part shall be applied under upset tail, thickness: 0. Damage free FRP material after installation. Verified force or clamping limit for ABS0056-B hollow end rivets.			
5	<b>Installed fasteners</b> - upset tail dimensions, csk protrusions, preformed csk heads, csk upset tails incl. ABS0056, cracks and deviations, gaps at rivet heads and in the faying surface, milling of csk.heads (if applicable), surface protection	- 4.1.4			

## 5 Technical Qualification

The Technical Qualification shall be performed according to the relevant Airbus procedure.

## 6 Rework

Rework and repair of holes and fasteners as per ABS1771.

## 7 Environment, Health and Safety

The manufacturing process shall be in line with Airbus Health and Safety and ecoefficiency policies.

Compliance with A1091 shall be ensured for all materials, substances and/or articles implemented during process.

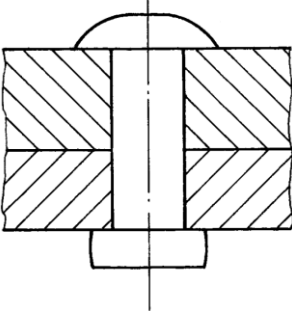
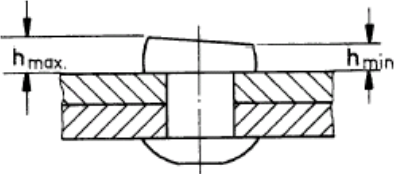
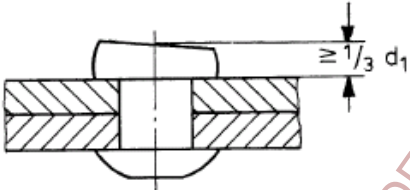

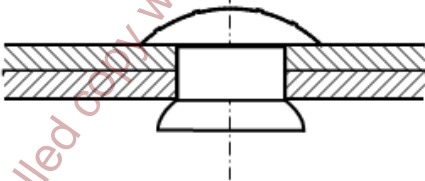
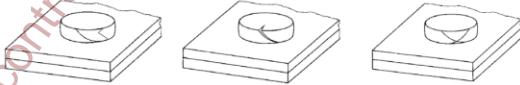
In particular, targeted substances according to A1091 shall not be used, if a safer alternative is available.

Uses made of all substances involved in the process shall be documented in Safety Data Sheet as required by REACH regulation (Registration Evaluation and Authorization of Chemicals).

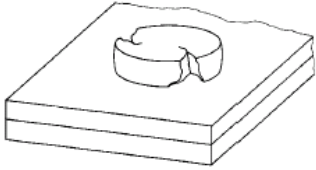
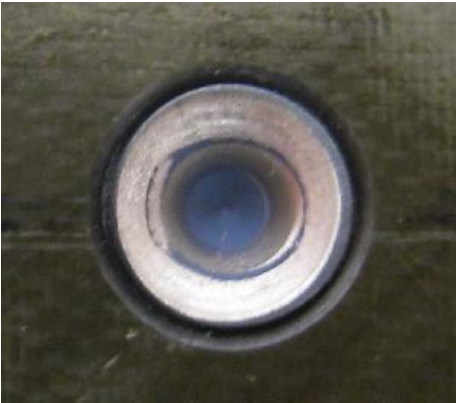

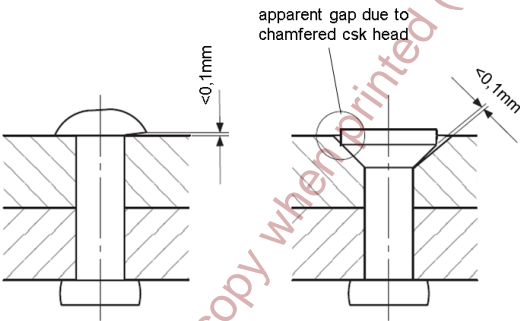


## Annex A (normative)

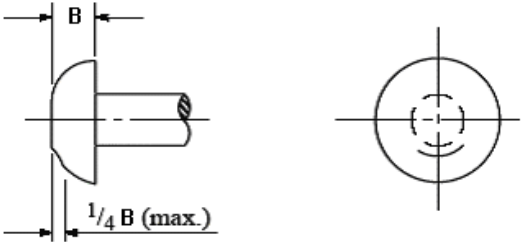
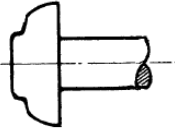
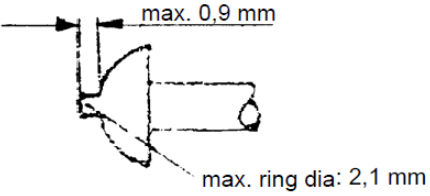
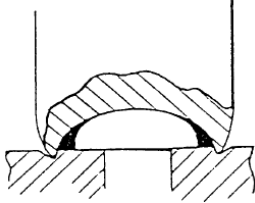
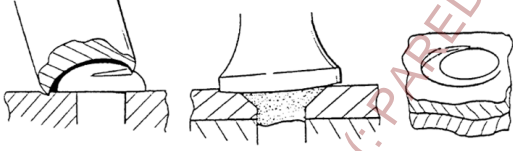
**Table A.1: Solid rivets – Reference & Typical Defects (Examples)**

Type of defect		Acceptance criteria
	<p>Correct installation (upset tail correctly formed &amp; no gaps)</p>	<p>Acceptable (reference)</p>
	<p>Upset tail with sloped surface</p>	<p>Acceptable as far as <math>h_{min}</math> and <math>h_{max}</math> within allowed tolerance (see Table 7, Table 8).</p>
	<p>Upset tail below <math>h_{min}</math> on one side</p>	<p>Acceptable as far as not more than 10 % of rivets in one row are concerned and mean height is not below <math>1/3 \times d_1</math>. This defect shall not occur on solid rivets located at either end of a rivet row. In between, not more than two effected rivets shall be adjacent to one other.</p>
	<p>Displaced formed upset tail</p>	<p>The upset tail of a solid rivet may be displaced with respect to the shank provided its dimension is within the tolerance. If the upset tail touches the shank perimeter or the edge of the rivet hole is visible, the fault is not acceptable and the rivet shall be replaced. In fuel tank applications, a displaced upset tail which is recognizable by its oval shape shall be replaced.</p>
	<p>Bell shaped upset tail</p>	<p>Not acceptable, fault is resulting from not permitted installation tools (e. g. back up bar of insufficient weight or rivet gun with too low forming capacity).</p>
	<p>Cracks on upset tail</p>	<p>Not acceptable.</p>

**Table A.2: Solid rivets – Typical Defects (Examples)**

Type of defect		Acceptance criteria
	Longitudinal cracks (clefts) on upset tail	Not acceptable. Longitudinal cracks caused by incorrect heat treatment thus too hard rivets or due to surface defects of the rivet by opening laps. These defects are generally not caused by faulty riveting.
	Local deformation of ABS0056 hollow end rivet's upset tail	Acceptable if the outer diameter of the countersunk upset tail is formed into the countersink without showing gaps.
	Cracks at upset tail of ABS0056 hollow end rivet	Not acceptable.
	Gap between component and rivet head	Acceptable if <0,1 mm. On 10 % of the solid rivets the gap may be 0,1 mm (a 0,1 mm feeler gauge begins to clamp in the gap just at the entry, when the gap is equal 0,1 mm) and adjacent rivets do not show the same fault. An "apparent" circumferential gap at the countersunk head at the level of the countersunk head chamfer is permitted. In case of wet installed solid rivets, sealing of gaps resulting from measuring is mandatory. Countersunk upset tails of solid shank and hollow end solid rivets shall exhibit no gaps. Gaps are not permitted at integral fuel tanks and pressure cells. The gap for universal head solid rivets may exceed 0,1 mm when installed on a curved surface (> 0,1 mm in curve direction).

**Table A.3: Solid rivets – Typical Defects (Examples)**

Type of defect		Acceptance criteria
	Notch in the universal head	Acceptable if not exceeding $\frac{1}{4}$ of head height B.
	Concentric ring in universal head	Not acceptable, resulting from too small rivet die.
	Concentric ring on universal head	Acceptable only for aluminum alloy solid rivets. if within limits (height below 0,9 mm, maximum diameter 2,1 mm). This fault can occur if the solid rivet is held in the rivet die by vacuum.
	Structural damage due to too large riveting die	Not acceptable
	Structural damage due to crookedly held riveting die	Not acceptable

## RECORD OF REVISIONS

Issue	Clause modified	Description of modification
1 05/07	all	New standard
2 04/10	4.1.5	Implementation of Key Characteristics
3 03/11	All 2 3.2  3.3  4.1.1.1  4.1.1.2 4.1.3 4.1.3.2 4.1.3.3 4.1.4.5 4.1.4.6, 4.1.4.7 4.1.4.8. 4.1.4.9 4.3 6 7 8 Annex A Tables Figures	<p>New AIPS template is used and standard is editorially revised</p> <p>A1091, ABS0056-B, ABS1771, AITM10070, AIP03-11-001, AIPS05-02-011 added</p> <p>Added: Hollow shank rivets from alloy T40 to be installed by squeezing, applicability of AIPS01-01-004 when invoked in drawings of other Airbus programs.</p> <p>Added: Installation of ABS0056-B and of universal head rivet, countersunk upset tail of solid shank rivets not in FRP sheet, no shank expansion on ABS0056-B, no solid shank rivets in injection molded brackets, remaining min. cylindrical part in the csk. sheet per applicable design principles.</p> <p>Added: Burrs at holes and deburring, countersunk head protrusions of ABS0056-B, dimensions for csk. upset tails of ABS0056-B, milling of csk. head of 100° normal head rivet cancelled, as rivet is not applicable, AIPS03-11-001 applicable for milling of countersunk heads, max csk. head protrusion per drawing requirements.</p> <p><math>Ra \leq 3,2 \mu m</math> applicable for metallic material.</p> <p>Added: Rivet length for ABS0056-B, grip measurement on sloped surfaces.</p> <p>Rivet length for countersunk upset tails of solid shank rivets and milling of protruding material revised.</p> <p>Shank of ABS0056-B not to be cut to length.</p> <p>Sheet / washer thickness per Table A.1 (Annex A) added.</p> <p>Table 2 and 3: Renumbering of referenced Tables and Figures of Annex A.</p> <p>Added: Gaps in the faying surface per AIPS-01-02-017.</p> <p>Added: New subchapter "Surface protection".</p> <p>Table 4: "Key Characteristics" revised.</p> <p>New chapter "Rework".</p> <p>New chapter "Environment, health and safety".</p> <p>New tables related to ABS0056-B added and tables partly renumbered.</p> <p>New figures related to ABS0056-B and for burrs in metallic materials and figures partly renumbered.</p> <p>Figure A.1, A.5 and A.13 revised.</p> <p>Former Figure A.16 cancelled as included in AIPS01-02-017.</p>
4 07/14	2, 3.2, 4.1.1.1, 4.1.4  4.1.1.1  4.1.1.2  4.1.4  4.3 All All	<p>EN6080 solid rivets with normal flush head added.</p> <p>Deburring mandatory if components are removed after drilling. Countersink perpendicularity limit for ABS0056 added.</p> <p>Recommendation of uncoated / not anodized hole surface instead of mandatory requirement.</p> <p>Verified installation force or clamping limit for ABS0056-B hollow end rivets in FRP mandatory.</p> <p>Countersink KC refined.</p> <p>Editorial revision.</p> <p>Scope extended by ABS0056-A hollow end rivets.</p>

(Continued)

**RECORD OF REVISIONS**

Issue	Clause modified	Description of modification
5 08/17	2 4.1.4.  Table 9 Table 10	"EN6101::" to "EN6101:" changed. Wording min and max to min. and max. changed. Paragraph "Assembly with ..." new. "Solid rivets...": Dimension +0,01 to +0,05 changed. Type B: Dim. max. from 0,01 to 0,10 changed. Type A: Dim. min. -0,00 to 0,00 changed.
6 02/18	4.1.4  All	Text added: Minimal flushness .... (CPPR 6709)  Corrected: Links to Figures and Tables lost
7 03/18	4.1.4	Assembly with anchor nuts only chapter re-worded to resolve installation issues.