

Ergonomics Specification for Manually Seated Fasteners

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**ERGONOMICS SPECIFICATION
FOR MANUALLY SEATED FASTENERS**

TABLE OF CONTENTS

1.	SCOPE.....	2
2.	REFERENCED DOCUMENTS	2
3.	GENERAL	2
4.	ASSEMBLY FORCE AND DESIGN GUIDELINES.....	3
4.1	Maximum Assembly Force Guidelines.....	3
4.2	Contact Surface Characteristics	3
5.	TEST METHODS	7
6.	HAND CLEARANCE GUIDELINES	7
APPENDIX A	GLOSSARY	9
APPENDIX B	SAMPLE SURFACE AREA CALCULATIONS.....	10
APPENDIX C	TESTING SPEED PROTOCOL	12
APPENDIX D	REFERENCES.....	13
APPENDIX E	REVISIONS.....	14
Figure 1		4
Figure 2		4
Figure 3		4
Figure 4	Finger length and width.....	8
Figure 5	Two finger width	8
Figure 6	One finger and hand width.....	8
Figure 7	Hand posture to align and seat fastener, option 2	8
Figure 8	Hand posture to align and seat fastener, option 2	8
Table 1	Manually installed clip force and design guidelines	6

1. SCOPE

This document describes the assembly force guidelines for manually seated push-pins, clips, and similar retention devices. For the purpose of this document, the term “clip” is used to reference all retention devices addressed within this document. Applicable retention devices must have force exerted directly to the clip using the finger/thumb and are hand seated independent of other fasteners. For a retention device to be manually installed and seated independent of other retention devices, it must be seated fully without any interaction with an adjacent fastener (i.e., multiple PIA clips on the back of a hard trim panel).

This standard applies to contact surfaces angled at 90 degrees (± 10 degrees) and/or perpendicular from the direction of force insertion. Mechanically installed fasteners (screws, rivets, etc.) are not included in this document. This standard does not apply to extraction/retention forces. Refer to USCAR-44 for additional guidelines for clips attached to wire harnesses.

All possible design and applications could not be anticipated in creating this guideline. Pictures and examples are included throughout to assist. Where there are questions of adherence to the guideline, consult the responsible ergonomic departments or representatives.

2. REFERENCED DOCUMENTS

USCAR-25	Ergonomics Specification for Electrical Connections
USCAR-43	Shipping Caps, Torque Caps, and Body Plugs Ergonomic Design Criteria
USCAR-44	Performance Specification for Automotive Wire Harness and Connector Retainer Clips

See additional references in Appendix D.

3. GENERAL

Part packaging, process, and workstation design requirements/constraints all have the potential to negatively impact the maximum assembly forces outlined in this document. Such situations include, but are not limited to:

- Obstructed access (hand/finger clearances)
- Operator awkward or non-neutral postures, such as wrist deviation or extended reaches
- Forces applied laterally across the operator's body
- Contact surface area
- Forces applied overhead

Consult the responsible ergonomic departments or representatives with any questions or if clarifications are needed.

4. ASSEMBLY FORCE AND DESIGN GUIDELINES

A clip is used to manually fasten parts with a hand/finger(s). Each clip type is divided into one of three classes, as shown in Table 1. Each class is defined by maximum assembly force, minimum contact surface area, minimum contact surface dimension, and the typical hand or finger posture used to install the clip.

4.1 Maximum Assembly Force Guidelines

Assembly force values, as defined in Table 1, accommodate the strength capability for the working population. When non-ideal conditions are present, as outlined in Section 3, the maximum assembly force may be reduced. Specifically, obstructed access can cause concern for operator access to align and seat the clip which will result in reduced maximum assembly force regardless of available contact surface area. See Section 6 for additional details on hand and finger clearance dimensions to minimize the risk of access/packaging concerns. In all cases, assembly forces shall not exceed the applicable force guidelines for the clip while maintaining functional performance. Consult the responsible ergonomic departments or representatives with any questions or clarifications related to non-ideal conditions and assembly force.

4.2 Contact Surface Characteristics

The contact surface is a continuous plane upon which the operator can apply force to the clip. Contact surface dimensions accommodate a gloved hand (see Section 6). The minimum contact surface area shall be met. These dimensions are provided in Table 1.

Measuring contact surface area shall be based on criteria defined below. Acceptable contact surface areas need to account for areas of the retainer clip that an operator would interface with to manually seat the clip. When applicable, sum the acceptable contact surface areas to determine the total available contact surface area.

Appendix B provides specific examples related to surface area calculations for different retainer clip scenarios.

- 4.2.1 The minimum surface area requirement is 15 mm² for a Class 1 clip, with a minimum required dimension of 3 mm, under the assumption that the operator is able to access the clip without obstruction. Contact stress limitations necessitate this 3 mm dimension.
- 4.2.2 The minimum surface area requirement is 100 mm² for a Class 2 clip, with a minimum dimension of 5 mm, under the assumption that the operator is able to access the clip during install without obstruction.
- 4.2.3 The minimum contact surface area requirement is 150 mm² for a Class 3 clip, with a minimum dimension of 5 mm, under the assumption that the operator is able to access the clip without obstruction.
- 4.2.4 For Class 2 and Class 3 clips, two digits may be required to seat clip. Additional details regarding contact surface area requirements are outlined in Table 1.
- 4.2.5 Design potential contact surfaces to avoid pressure points. In some situations, knurls or serrations can be used to improve grasp, provided they do not create uncomfortable pressure points. Serrations, knurls, and ridges greater than 0.8 mm in height are not acceptable (see Figures 1 and 2). For clips with an arched push surface (see edge clip in Figure 3), the minimum edge radius must be greater than or equal to 1.5 mm.