

Shipping Caps, Torque Caps, and Body Plugs Ergonomic Design Criteria

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1.0 SCOPE

This document describes the design and assembly force guidelines for conventional shipping caps, torque caps, and body plugs.

All possible design and applications could not be anticipated in creating these guidelines. Where there are questions of adherence to this document, such as use of an “off-the-shelf” design, always consult the responsible Ergonomics Department.

2.0 REFERENCED DOCUMENTS

SAE/USCAR-25 Electrical Connector Assembly Ergonomic Design Criteria

3.0 GENERAL

In all cases, **assembly forces should be as low as possible** while maintaining satisfactory performance and quality.

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

- Obstructed Access
- Awkward or non-neutral postures, such as wrist deviation or extended reaches
- Force applied laterally across the body.

Reference the Hand Clearance guidelines in SAE/USCAR-25 Section 9.0. Consult the Ergonomics Department with any questions or if clarifications are needed.

4.0 DESIGN GUIDELINES – SHIPPING CAPS

A shipping cap is used to prevent leakage or contamination during shipping and can be made from different materials, such as vinyl, rubber or plastic. They may be installed and/or removed by the operators without an assist (i.e. hand tool). Key factors that must be considered in the design or selection of shipping caps/plugs are the push/pull forces required for insertion/removal, the grasp/grip surface area, the hand or finger grip posture utilized, and the composition/material of the cap or plug. Shipping caps fall into three classes as shown in Table 4.0 (See page 4). Each class is defined by maximum assembly force and corresponding surface area requirements.

4.1 MAXIMUM ASSEMBLY FORCE

Under the ideal conditions described under these guidelines, the maximum assembly forces must not exceed 75N. When these conditions cannot be met, the maximum assembly force is reduced as shown in Table 4.0.

4.2 DESIGN REQUIREMENTS

Required surface area dimensions are determined by the hand or finger grip utilized. Surface area requirements are derived from a large male gloved hand or small female gloved hand as appropriate. Shipping caps/plugs should be designed according to the surface area requirements shown in Table 4.0. For large caps that can be assembled and/or removed with the whole hand, a minimum surface area of 500mm² is required.

Shipping caps/plugs should have features to facilitate their removal such as: rings, tabs, or raised flanges.

- a. Pull rings should be designed with an inside diameter of at least 25.4 mm (See Figure 1).
- b. The optimal measurements of a pull tab (See Figure 2) should be a minimum of 23 mm in length by 6 mm in width.
- c. A raised flange or ridge (See Figure 3) around the periphery of a cap should have a minimum height of 2 mm from the surface of the cap.