# Clevis Load Pin Installation

**I. Clevis pin orientation and loading**

The purpose of the anti-rotation devices is to provide and maintain proper angular (a) alignment of the load/clevis pin with the force P. Strain gage circuit orientation in the load pin is based on the force angle a.

When the eye is in a structurally fixed position, the forces P/2 are applied through and in the axial direction of the clevis, but at varying angularity with the eye, then a keeper plate (B or C) type device will be required.

In load pins with Dp less than two inches, the keeper plate (c) will retain in one direction only, requiring a retaining ring or nut. (However no axial forces should be applied to the load pin during installation or use).

With the clevis structurally fixed in position, and the force P applied through and in the axial direction of the eye, but at a varying angularity with the clevis, a different type key (D or E) may also be required.

Spacers are useful to take up excessive clearance between clevis and the eye, to minimize the lateral motion of the load pin, and to fix the location of the internal strain gage installations in the shear planes between the clevis and the eye.

**II. Recommended dimensional tolerances and material properties**

The performance of the instrumented load pin depends upon the quality and strength of the load pin metal and the dimensional accuracy of the pin. The total performance of the pin depends upon the quality and strength of the clevis and clevis eye where the load pin is assembled.

*The two important characteristics of the clevis and the clevis eye are:*

1. Diametral clearance between the pin and clevis
2. Compressive yield strength of the bearing surfaces that they apply forces to the load pin.

The length of the bearing surfaces compared to the load pin diameter, are also important, but only when these dimensions are either too short or too long. Under normal proportions on the load pin, the length is not a critical factor.

*Recommended clearances between load pin, clevis and clevis eye; this depends on practical considerations and technical aspects.*

The clearance is a function of diameter, and the following values are recommended for typical applications:

**Pin Diameter, Inch**
1.00 to 2.00 inch
Above 2.00 inch
**Precision Fit Min. Clearance**
0.002 inch
0.0001 inch per inch diameter
**Average Fit & Clearance**
0.003 to 0.004 inch
0.0015 to 0.0020 inch per inch diameter
**Loose Fit Max. Clearance**
0.006 to 0.010 inch
0.004 inch per inch diameter

**III. Load pin installation**

Larger clearances are not a serious problem as far as accuracy is concerned. This however, as illustrated, will increase the contact stress between the load pin and the clevis. Thus, if large clearances are used, the assembly will be accurate only at lower loads. At high loads, the yield stress in the clevis metal may cause measurement errors not due to the load pin.

**A. Diametral clearance of pin**

The effect of diametral clearance is graphically shown in the end-view of the pin. When the clearance is small, the contact region approaches the entire pin diameter. As the clearance ratio increases, the contact area is reduced, and the total force is distributed over a small area. Thus, the bearing strength of the clevis can be lower when the clearances are smaller, assuming that the same force is to be measured by the load pin.

**B. Non-uniform force distribution along the length of the pin**

The effect is illustrated in the side view of the load pin. The approximate force distribution on a typical load pin (along its length) is shown by the shaded area. The force is a maximum at the inner edges of the clevis and at the outer edges of the clevis eye. The exact distribution varies from one installation to another. It is assumed that the two bored holes in the clevis are accurately in line, so that the load pin is not "titled" when installed. It is important to consider that length dimensions A and B cannot be increased indefinitely to increase the strength of the bearing surfaces.

*Recommended material properties of clevis and clevis eye*

The bearing stresses between the load pin, the clevis and the clevis eye/sheave are larger than the average calculated stress obtained by dividing the force by bearing area. There are two factors that cause this increase, and they are as follows:

1. Clearance between pin diameter and the bored holes.
2. Non-uniformity of the force along the supported length of the load pin.

**I. Diametral clearance of pin**

The effect of diametral clearance is graphically shown at the end of the pin. When the clearance is small, the contact region approaches the entire pin diameter. As the clearance ratio increases, the contact area is reduced and the total force is distributed over a smaller area. Thus, the bearing strength of the clevis can be lower when the clearances are smaller, assuming that the same force is to be measured by the clevis load pin.

**II. Non-uniform force distribution along the length of the load pin**

This effect is illustrated in the side view of the load pin. The approximate force distribution on a typical load pin along its length is shown by the shaded area. The force is a maximum at the inner edges of the clevis and at the outer edges of the clevis eye/sheave. The exact distribution varies from one installation to another. It is assumed that the two bored holes in the clevis are accurately in line so that the pin is not "tilted" when installed. It is important to consider that the length dimensions A and B cannot be increased indefinitely to increase the strength of bearing surfaces.

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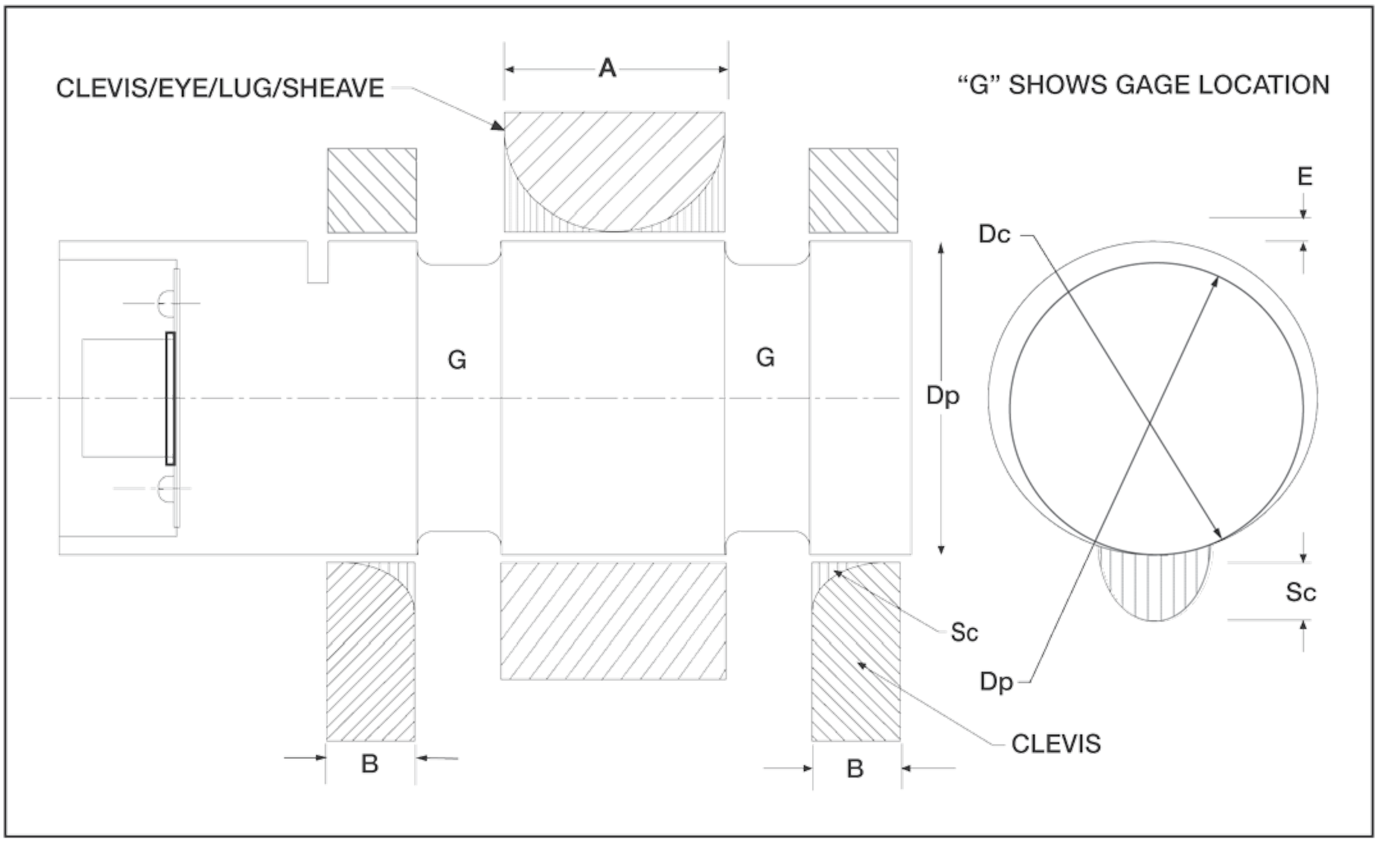
| NOMENCLATURE | | | |
|---|---|---|---|
| **A** | Length of contact between clevis eye/sheave and load pin | **S** | Average bearing stress between load pin & clevis or lug, psi |
| **B** | Length of contact at each end of the load pin by clevis | **Sc** | Peak stress applied by clevis or lug, psi |
| **Dp** | Exact diameter of load pin | **P** | Total force applied by the lug |
| **Dc** | Exact diameter of bored hole, clevis and lug | **Sc** | Depends upon ratio e/Dp and ratio B/Dp |
| **e** | Dc-Dp= diameter clearance between load pin & clevis | | |





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