Clevis Pin Installation

To maximize the measurement accuracy and performance of the STRAINSERT Clevis Pins, the following installation guidelines, including; pin orientation/loading, dimensional requirements, and material properties are provided.

In addition, Strainsert factory calibrations are intended to simulate installed conditions, however, it is recommended that an in-place calibration be performed to account for any installation, tolerance, and/or alignment influences affecting sensor measurement.

1. Clevis Pin Orientation and Loading

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

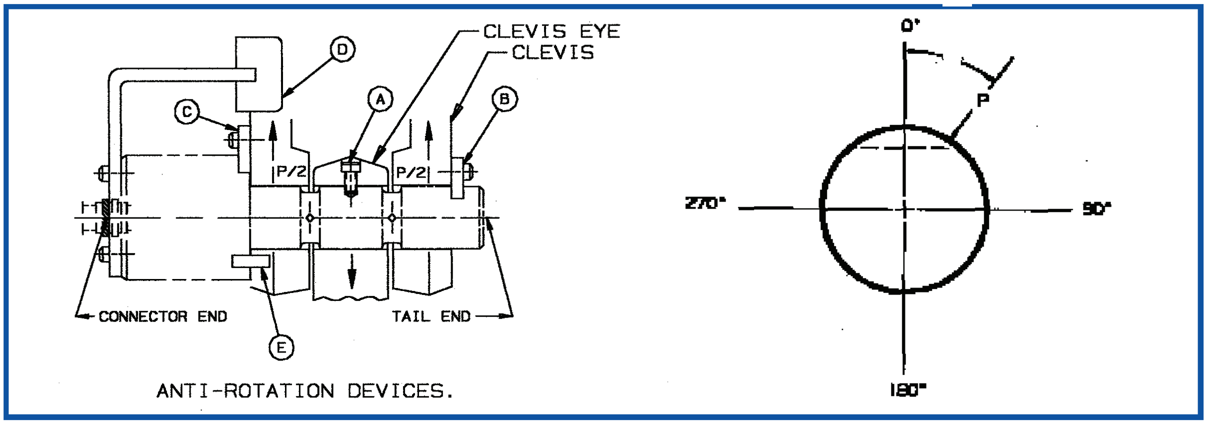
When the eye is in a structurally fixed position, and the forces P/2 are applied through and in the axial direction of the clevis, but at varying angularity with the eye, then a keeper plate (B or C) type anti-rotation device will be required.

In pin/bolts with D_P less than 2-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 clevis pin/bolt 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 key pin (A) type anti-rotation device may be required. When forces involved, and pin/bolt size or circumstances allow, a different type key (D or E) may also be considered.

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

α



2. Recommended Dimensional Tolerances and Material Properties

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

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

I – Diametral clearance between pin and clevis

II – Compressive yield strength of the bearing surfaces that apply force to the clevis pin.

The length of the bearing surfaces compared to the pin diameter are also important but only when these dimensions are either too long or too short. Under normal proportions of the pins as illustrated in the Strainsert standard clevis information, (CPA Series) the length is not a critical factor.

Recommended Clearances Between Clevis Pin, Clevis and Clevis Eye

This depends upon practical considerations, and technical aspects. The clearance is a function of diameter, and the following values are recommended for typical applications:

Pin Diameter, Inch	Precision Fit Min. Clearance	Average Fit & Clearance	Loose Fit Max. Clearance
0.375 inch to 1.000 inch	0.0010 inch	0.002 inch	0.004 inch
1.000 inch to 2.000 inch	0.002 inch	0.003 inch to 0.004 inch	0.006 inch to 0.010 inch
Larger than 2.000 inch	0.001 inch per inch diameter	0.0015 to 0.0020 in. per in. dia.	0.004 inch per inch dia.

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Larger clearances are not a serious problem as far as accuracy is concerned. This, however, will increase the contact stress between the clevis pin and clevis as illustrated in the figure below.

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 clevis pin.

Recommended Material Properties of Clevis and Clevis Eye

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

I – Clearance between pin diameter and the bored holes.

II – Non-uniformity of the force along the supported length of the clevis pin.

I: DIAMETRAL CLEARANCE OF PIN

The effect of diametral clearance is graphically shown below in the end-view of the pin. When the clearance is very 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 pin.

II: NON-UNIFORM FORCE DISTRIBUTION ALONG THE LENGTH OF THE PIN

This effect is illustrated in the side view of the pin. The approximate force distribution on a typical clevis 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 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 the bearing surfaces.

NOMENCLATURE			
A	Length of contact between clevis eye and clevis pin	S	Average bearing stress between pin and clevis or lug, psi
B	Length of contact at each end of pin by clevis	Sc	Peak stress applied by clevis or lug, psi
Dp	Exact diameter of clevis 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 = Diametral clearance between pin and clevis or lug