UTBASE Corrosion Testing
Determining Optimal Materials

Campbell Scientific equipment has been installed in a wide variety of conditions around the world. Mounting structures are fundamental and critical for data acquisition systems. Campbell Scientific designs and manufactures most of our mounting systems and are committed to continuous improvement of our products.

For many years, the B18 has been our most common base for the 6 and 10 m (20 and 30 ft) towers. This base consists of tubes used as extensions to the tower legs that are embedded in a concrete pad (Figure 1).

Figure 1: B18 and Tower Installation

Prior to placing concrete, the B18 tubes must be attached to the lowest tower section, and the tower trued. Adjustments to level the tower are not possible after the concrete has cured.

While galvanic corrosion due to the transition from the steel B18 to the aluminum tower has not been an issue, the B18 is susceptible to corrosion, particularly in the presence of salts such as in coastal environments or roadway installations (Figure 2). Once corrosion structurally compromised the B18, the user had to take down the tower, pour a new concrete pad, and reinstall the B18 base and tower.

Figure 2: Corrosion in a coastal environment

Campbell Scientific had three goals in developing the UTBASE.

1. Simplify the installation process.
2. Provide a way to level the tower after the concrete is cured.
3. Minimize the potential for corrosion, especially for parts that are difficult to replace.

The UTBASE is easier to install than the B18, is adjustable after the concrete has cured (see manual for details), and does not require a tower section during installation (Figure 3). The anchor bolts are 316 stainless steel to minimize corrosion at the concrete mounting point of contact.

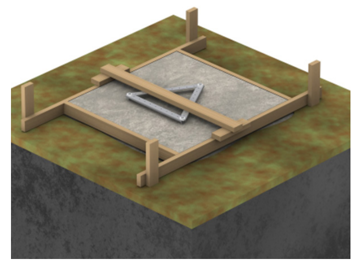


Figure 3. UTBASE installation rendering

Direct contact between the aluminum tower and stainless steel anchor bolts can create a galvanic or bimetallic reaction that enhances and accelerates corrosion. Therefore, Campbell Scientific needed to identify the optimum materials that transitions from the stainless-steel anchor bolts, to the clevis, to the connecting tubes, then to the aluminium tower.

Two tests were performed to examine corrosion with different combinations of materials for the tower base parts. Figure 4 shows the parts included in each assembly.

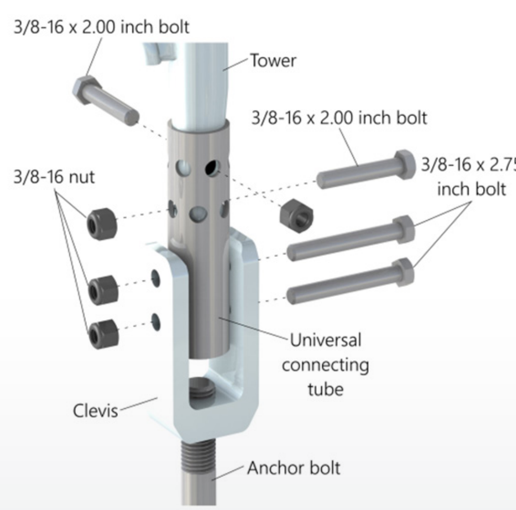


Figure 4. Exploded view of UTBASE

The two tests used six assemblies with different materials (see Table 1). The first test was a 96-hour salt fog test at Rocky Mountain Testing in Ogden, UT, USA using the ASTM B117 standard test procedure. The second test placed the six assemblies on the shore of the Great Salt Lake at a salt collection pond for 21 days.

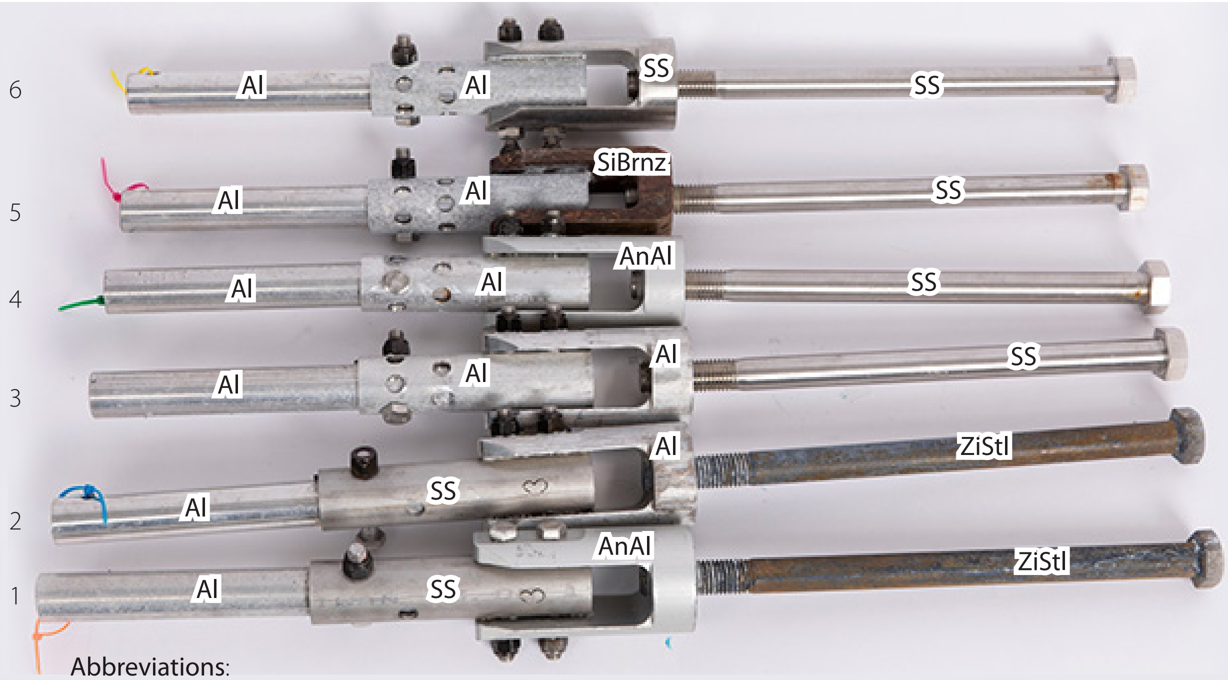
<table>
<tr><th>Assembly</th><th>Tower section</th><th>Connecting tube</th><th>Nuts/bolts</th><th>Clevis</th><th>Anchor bolts</th></tr>
<tr><td>6</td><td rowspan="6">6063 Al</td><td rowspan="4">6061-T6 Al</td><td rowspan="6">304SS black oxide / 316 SS</td><td>316SS</td><td rowspan="4">316SS</td></tr>
<tr><td>5</td><td>Silicone bronze</td></tr>
<tr><td>4</td><td>Anodized 6061-T6 Al</td></tr>
<tr><td>3</td><td rowspan="2">6061-T6 Al</td></tr>
<tr><td>2</td><td rowspan="2">304SS</td><td rowspan="2">Zinc-plated steel</td></tr>
<tr><td>1</td><td>Anodized 6061-T6 Al</td></tr>
</table>

Table 1. Assembly materials

The tests key results are summarized in Table 2 and Figure 5.

<table>
<tr><th>Assembly</th><th>Tower section</th><th>Connecting tube</th><th>Nuts/bolts</th><th>Clevis</th><th>Anchor bolts</th></tr>
<tr><td>6</td><td rowspan="4">Good</td><td rowspan="2">Significant corrosion</td><td rowspan="6">Minor, under nut/bolt head</td><td>Good</td><td rowspan="3">Good</td></tr>
<tr><td>5</td><td>Significantly blackened</td></tr>
<tr><td>4</td><td rowspan="4">Good</td><td>Minor, under nut/bolt head</td></tr>
<tr><td>3</td><td rowspan="2">Significant corrosion</td><td rowspan="2">Significant corrosion, could not turn in clevis</td></tr>
<tr><td>2</td><td rowspan="2">Some corrosion</td></tr>
<tr><td>1</td><td>Minor, under nut/bolt head</td><td>Some corrosion</td></tr>
</table>

Table 2. Corrosion results of different metals



Abbreviations:

SS – Stainless steel
Al – Aluminium
AnAl – Anodized aluminium
SiBrnz – Silicone bronze
ZiStl – Zinc-plated steel

Figure 5: Corrosion of the six assemblies

Assembly 4 performed the best. The anodization of the clevis provided sufficient insulation to minimize the reaction of dissimilar metals between the clevis and anchor bolt (see Figure 6). Applying anti-seize grease (included with the UTBASE) to the threads of the anchor bolt can provide additional protection against galvanic corrosion.

Campbell Scientific is not offering the clevis in stainless steel or bronze because of significant corrosion on the connecting tubes (Figures 5, 7).

Similarly, stainless-steel connecting tubes resulted in notable corrosion on the tower section (Figures 5, 8). The tower is the most difficult to replace, so avoiding corrosion at that point is critical.

Based on the test results, Campbell Scientific concluded the best choice for the UTBASE assembly is an anodized aluminium clevis, stainless-steel anchor bolts, and aluminium connecting tubes.

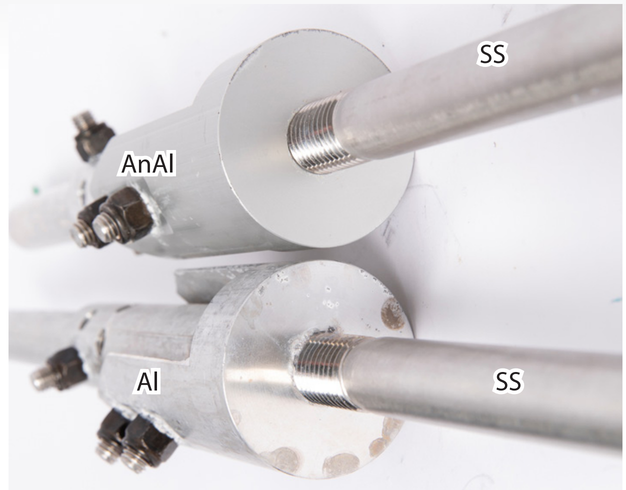


Figure 6. Clevis and anchor bolt from assembly 4 and 3

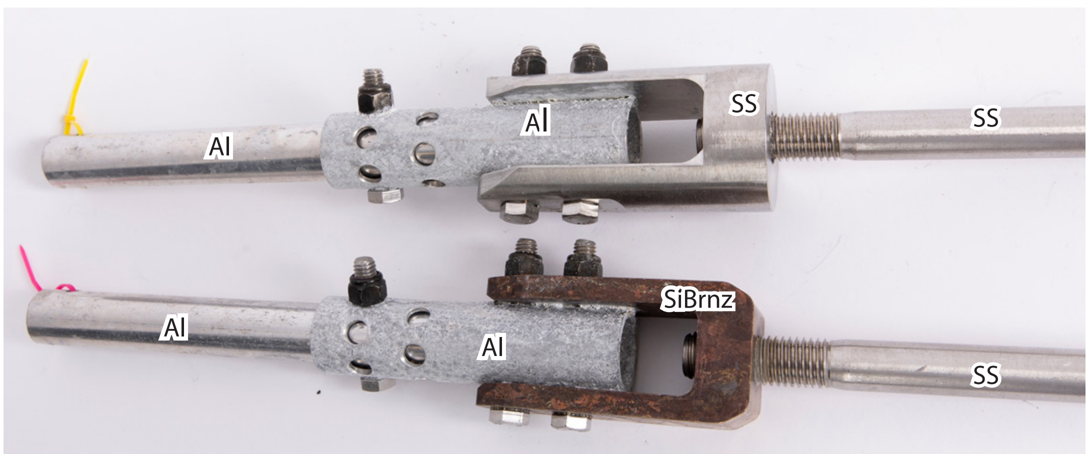


Figure 7. Assembly 6 and 5

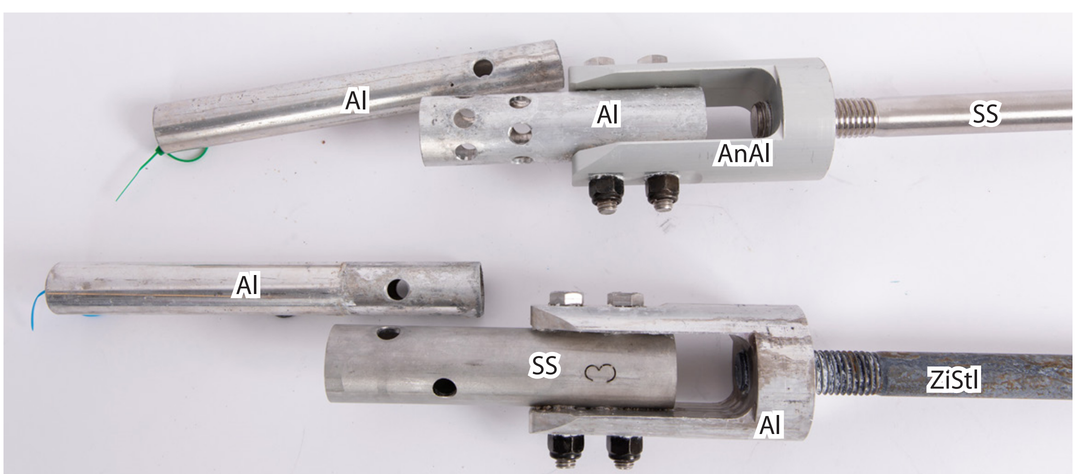


Figure 8. Assembly 4 and 2

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