Steering Column Performance Test Stand General Operating Procedure

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. To provide general guidelines for operating the Column Electric Power Steering (CEPS) Performance Test Stand.

1.2 Applicability. This test procedure is applicable to any steering column including electrically assisted.

1.3 Remarks. This document describes the general operating procedure for conducting a test on the Steering Column Performance Test Stand.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ISO 9001

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- AMETEK Programmable Power, Incorporated, Sorensen brand, San Diego, California (http://www.programmablepower.com/brands/sorensen.htm)
- Intrepid Control Systems, Incorporated, Madison Heights, Michigan (http://www.intrepidcs.com/)
- LMS, Siemens Product Lifetime Management Software Incorporated, Plano, Texas (http://www.plm.automation.siemens.com)
- MB Dynamics, Cleveland, Ohio (http://www.mbdynamics.com)
- Supercon, Incorporated, Shrewsbury, Massachusetts (http://www.supercon-wire.com)

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment. MB Dynamics CEPS Performance Test Stand includes the following components/software.

3.2.1 Driver Load Simulator (DS)-10. Simulate driver input conditions to column.

3.2.2 Driver Load Simulator (DS)-25. Simulate road input conditions to column.

3.2.3 Mounting Fixture. Used to mount brackets and column.

3.2.4 Integrated Absolute Angular Encoder. Measures the external position of steering column.

3.2.5 Torque Transducer. Used to measure the torque values of the DS-10 and DS-25 motor.

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3.2.6 MB Dynamics Application Software. Create and run test profiles for applicable tests.

3.2.7 LMS Data Acquisition. Records data for applicable tests.

3.2.8 Torsion Spring. Use for applicable test.

3.2.9 Adjustable Flywheel. Use to modify the momentum for applicable test.

3.2.10 Column Brackets. Use to attach column to fixture.

3.3 Test Vehicle/Test Piece. This test procedure applies to any steering column including electrically assisted.

3.4 Test Time. Time shown is typical per test and per test specimen.

Calendar time:	1 day
Test hours:	1 hour
Coordination hours:	0.5 hour

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Operator must be qualified and documented as capable to run this test as required by ISO 9001.

4 Procedure

4.1 Preparation.

4.1.1 Required Parts.

4.1.1.1 Steering Column. The following parts are required to test a column system:

a. Steering column assembly.

b. Steering column mounting bolts.

c. Proper wire harness (for CEPS system).

d. Special fixtures and/or brackets (if required).

4.1.2 Steering Column Mounting.

4.1.2.1 Installing Steering Column. Mounting is dependent upon the style of the steering column. Adjustable fixture mounts are used to help align the column to the DS-10 and DS-25, see Figure 1. The positioning of the fixture is dependent to each column. Multiple joints can be loosened to help with the installation process, see Figure 2 and Figure 3. A new bracket may be needed to attach CEPS if design does not fit current bracket dimensions.

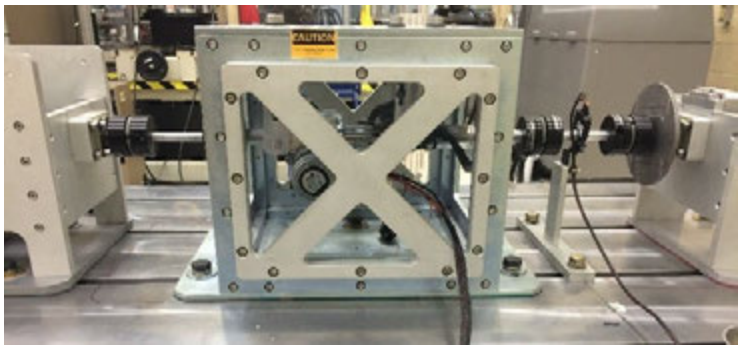

Figure 1: Display of Column Installed to DS-10 and DS-25 Motors

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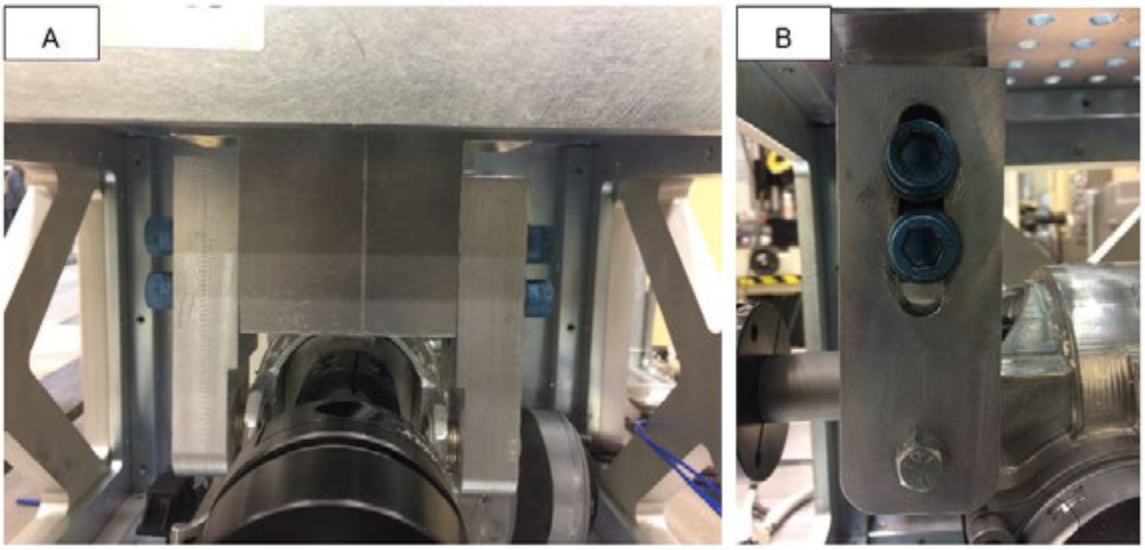
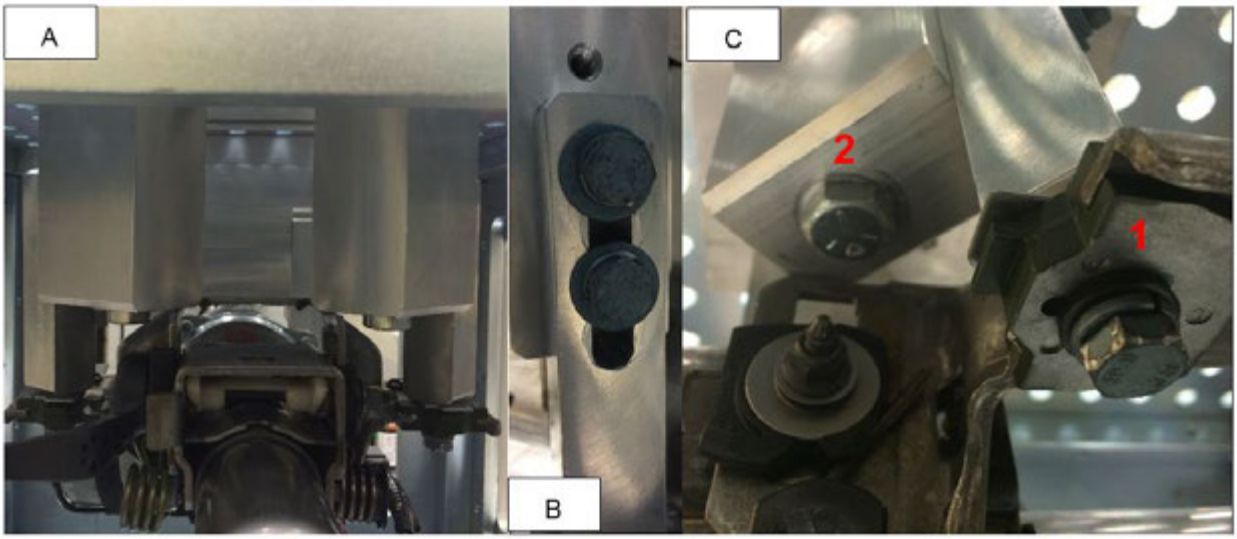


Note: (A): Displays the front view of the DS-25 Bracket to column.
(B): Displays the three bolts; Top two used to adjust the height of the column, and bottom one to fix the column to the bracket.

Figure 2: Display of the Output Shaft Assembled to Fixture and DS-25 Motor



Note: (A): Displays the front view of the DS-10 bracket to column.
(B): Displays two bolts used to adjust the slider, and a hole created to move the slider further up.
(C): Displays two bolts; one used to mount the column to the fixture (1), and another bolt used to secure the mount to the fixture box (2).

Figure 3: Display of the Output Shaft Assembled to Fixture and DS-25 Motor

4.1.2.2 Rigid Aluminum Shaft Installation. When installing the rigid alumni shaft to the CEPS Performance Test Stand, the torsion spring connected on the DS-10 motor side (shown in Figure 4) will need to be removed. First loosen the shaft collars on the adaptors, then loosen the two couplings. To install the rigid aluminum shaft and the couplings back into the section of the box and tightened, see Figure 5.

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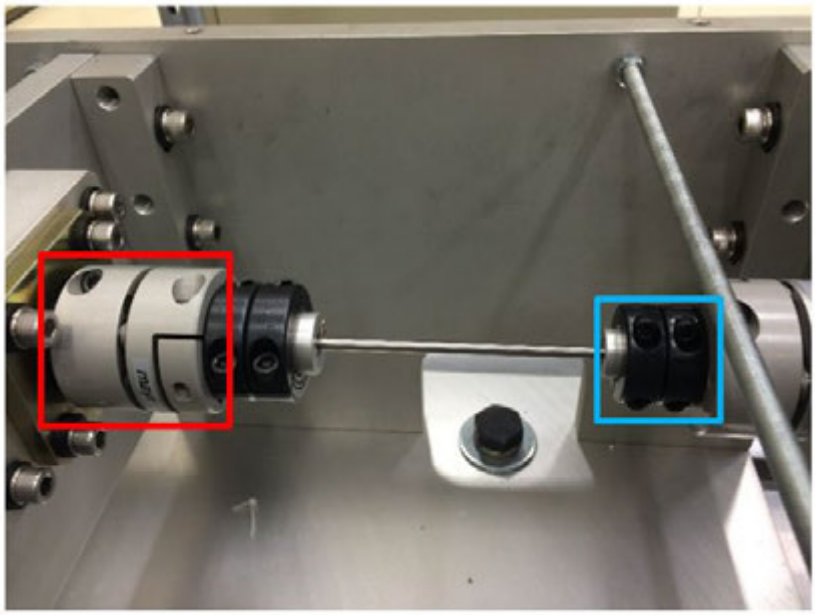

Note: Red Box displays the coupling and Blue Box displays the shaft collar.

Figure 4: Display of the Torsion Spring to be Removed for the Rigid Aluminum Installation

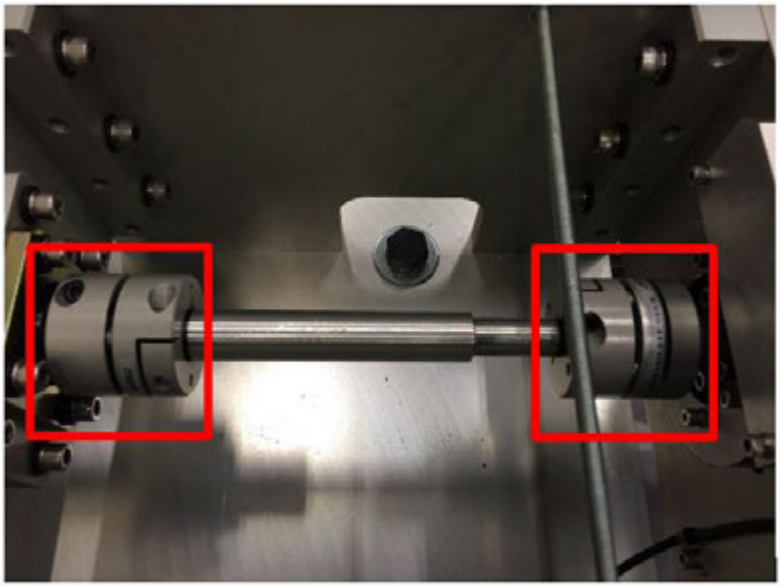

Figure 5: Rigid Aluminum Shaft (DS-10 Motor Box Assembly)

4.1.2.3 Torsion Spring Installation. In order to install the torsion spring to the CEPS Performance Test Stand (see Figure 6), the rigid aluminum shaft connected to the DS-10 motor in the second section of the box will need to be removed (see Figure 5). First, loosen the couplings that are attached to the shaft. After the couplings are loose, slide the couplings toward each other, which should provide enough room to remove the shaft.

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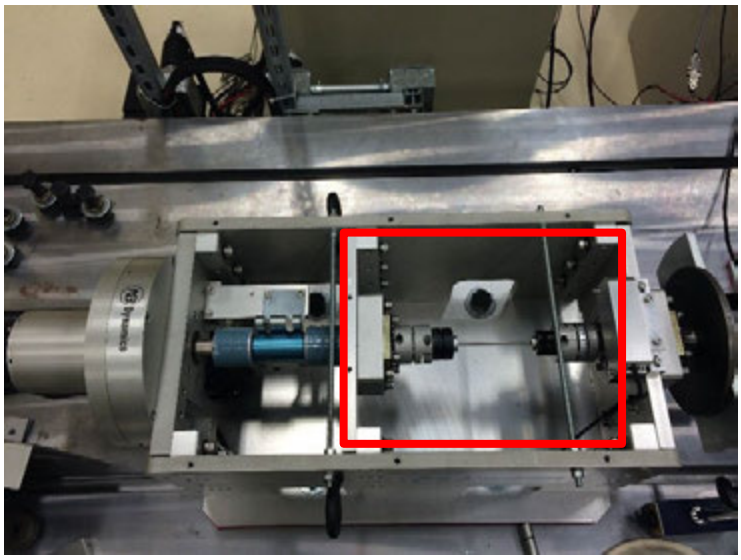

Figure 6: Torsional Spring (DS-10 Motor Box Assembly)

After removing the rigid aluminum shaft, install the torsion spring shown in Figure 7. Make sure there are a total of four (4) shaft collars, two (2) shaft adaptors (has two (2) different outer diameter sizes), a torsion spring, and the two (2) couplings used for the rigid aluminum shaft.

Figure 7: Torsion Spring with the Shaft Collars and Adaptors

Attach the torsion spring to the correct coupling. The couplings have different diameter sizes, as shown in Figure 8. The torsion spring should match the appropriate diameter sizes.

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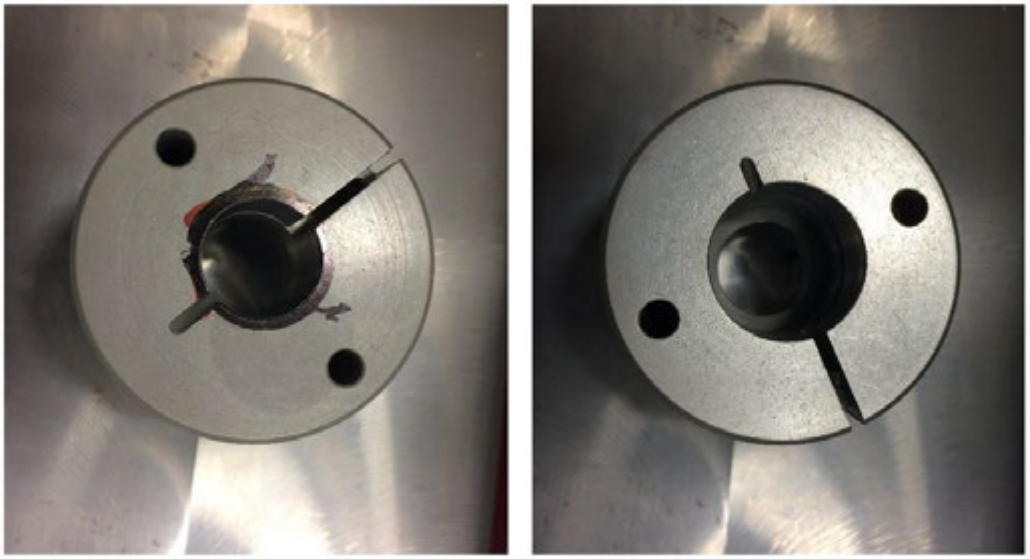

Figure 8: Example of the Different Diameter Sizes

After installing the torsion to the CEPS Performance Test Stand, make sure the couplings are secured to the shaft and the adaptors. Afterwards, align slit of the torsion spring adaptor (has only one slit) to the slit of both the shaft collars, as shown in Figure 9; this should be done on both ends of the torsion spring. Rotate shaft as needed. Once aligned, tighten shaft collars on both ends.

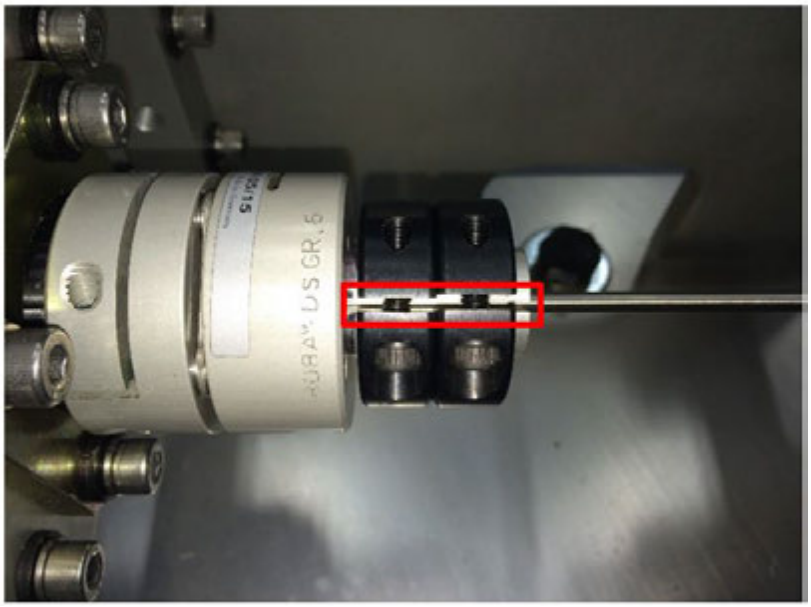

Figure 9: Aligning the Shaft Collar Slit to the Torsion Spring Adaptor Slit before Tightening

The final result of the torsion spring installation is shown in Figure 10. Double check all the couplings and shaft collars bolts are tight.

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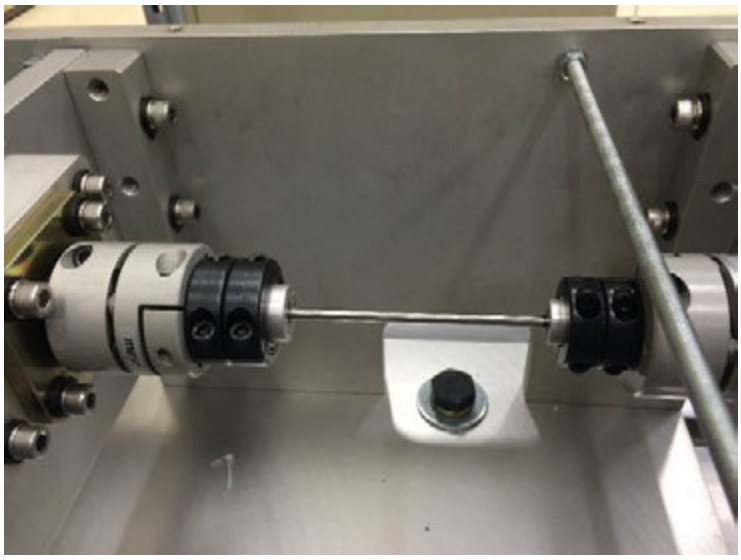
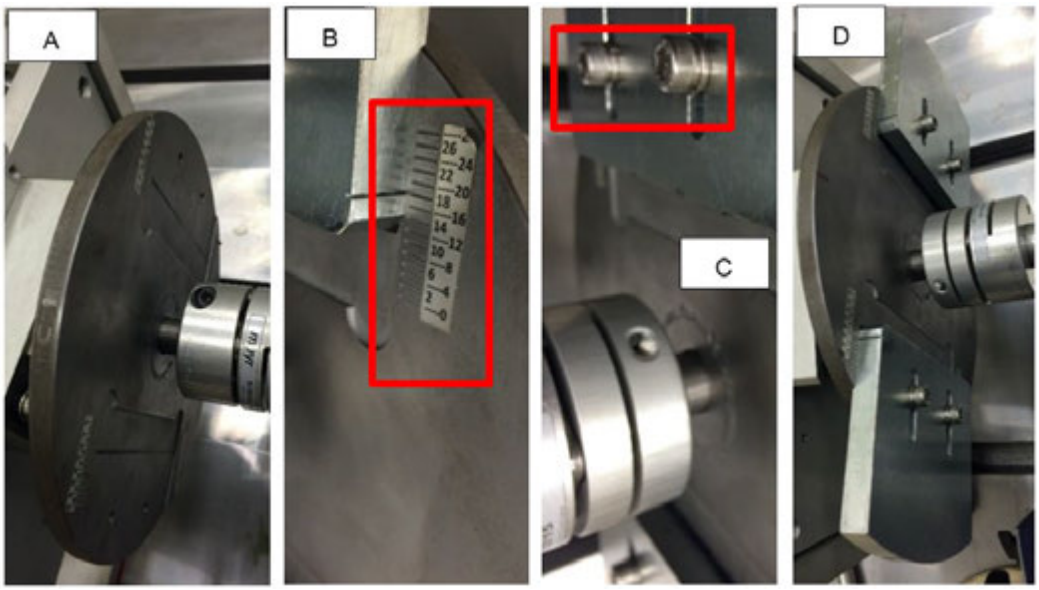


Figure 10: Final Result of the Torque Spring Installation

4.1.2.4 Mass Installation. To adjust the moment of inertia for the CEPS Performance Test Stand, attach the mass to the inertia wheel, as shown in Figure 11 (A). The distance from center is listed on the inertia wheel to help adjust the mass away from center, as shown in Figure 11 (B). The mass is attached to the inertia wheel by torqueing two bolts, as shown in Figure 11 (C). The final result of attaching the mass to the inertia wheel should look similar to Figure 11 (D).



Note: (A) Displays the flywheel used to attach the mass.
(B) Displays the distance from the center.
(C) Show the two bolts torqued when mass is positioned.
(D) Displays the final assembly of flywheel with mass (may change due to test parameters).

Figure 11: The Inertia Wheel and Mass

4.1.2.5 Steering Column to DS Motors. When installing the column to the fixture, attach the shaft adaptor shown in Figure 12 (A), using two shaft collars to tighten the adaptor on the column shaft (rack side). The two collars should be tightened to the shaft before moving to the next installation process. Loosen the two shaft

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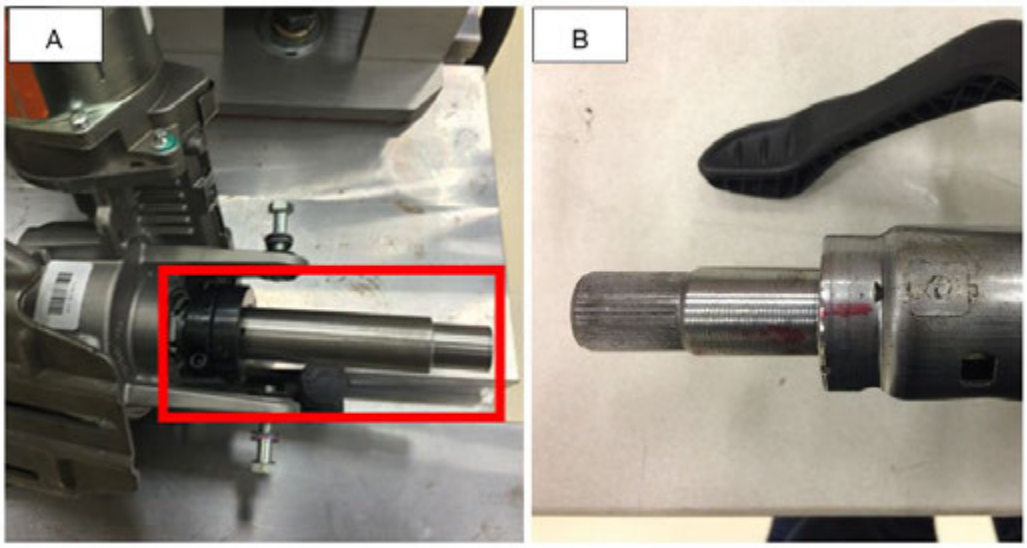
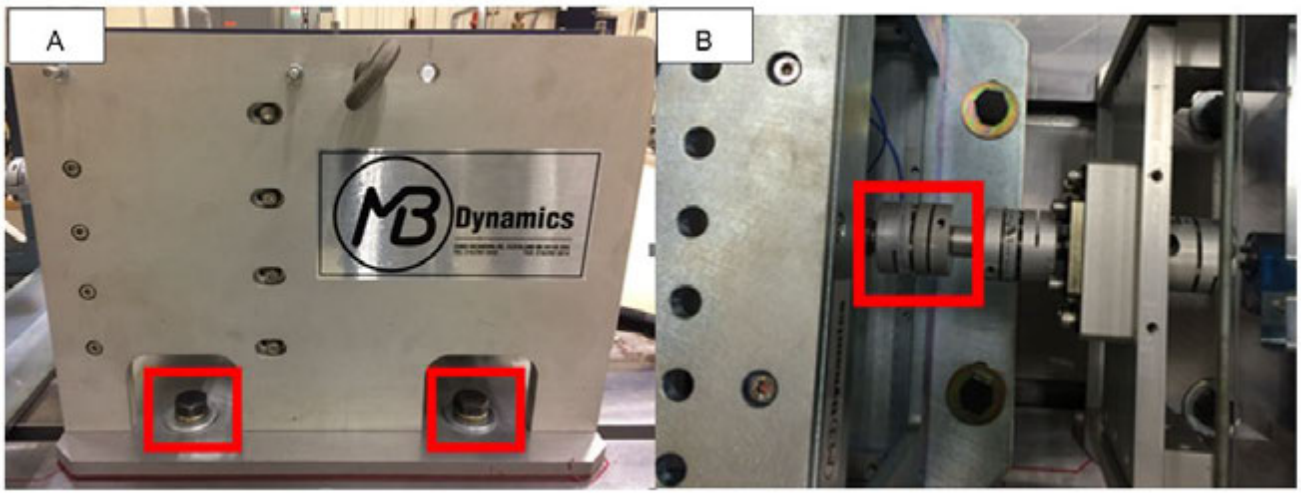
collars shown in Figure 12 (B), then fully insert the driver side shaft of the column until it bottoms out within adaptor. Tighten the shaft collars as tight as possible over the adaptor with the driver side shaft of the column inserted.



Note: (A): Shows the shaft adaptor used to connect the column to the DS-25 motor.
(B): Shows the shaft adaptor used to connect the column to the DS-10 motor.

Figure 12: Shaft Adaptors Connected to Column

Next, loosen the four bolts attaching the DS-25 to the test table; loosen until the bolts are able to turn by hand. Do not remove the four bolts. See Figure 13 (A) for DS-25 bolt locations. Loosen the coupling shown in Figure 13 (B). After loosening the DS-25 bolts and coupling, the DS-25 should be able to slide back and forth for assembly.



Note: The bolts are located on both sides of the box (A). Use the correct wrench to loosen bolts. A ratchet will not be able to fit in opening. Loosen the DS-25 coupling shown in (B), if not already detached from column.

Figure 13: DS-25 Alignment

Once the DS-25 motor is free to move, reposition the DS-25 motor as needed. Install the column to the fixture using the brackets shown in Figure 2 and Figure 3. If the distance between the column and DS-10 is an issue,

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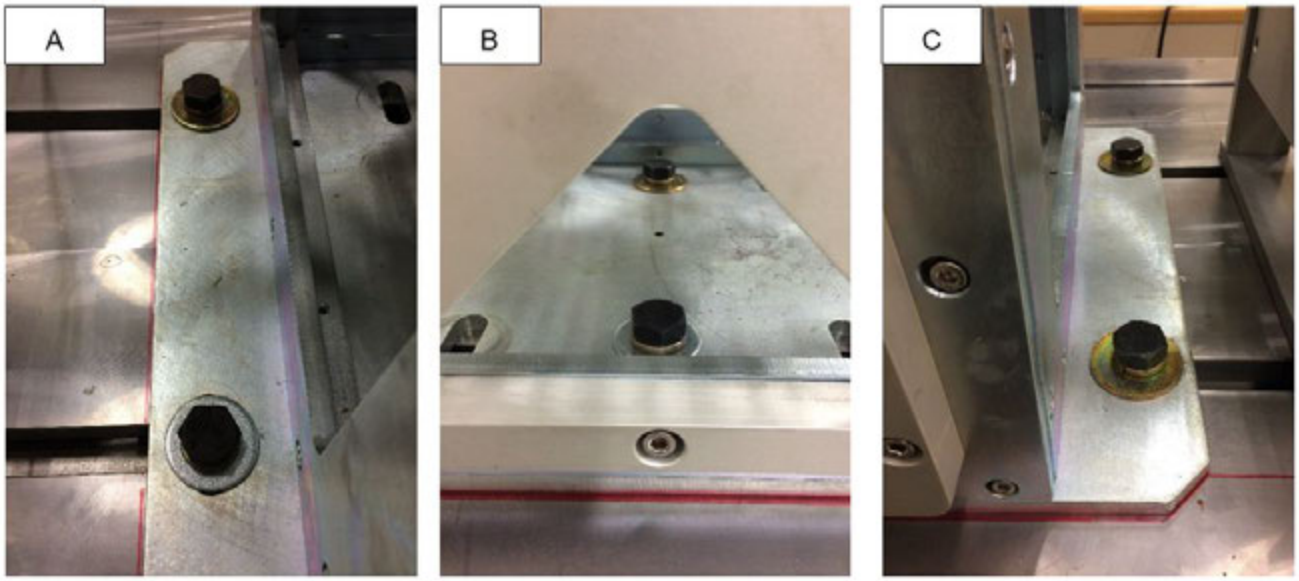
tester will need to compensate by adjusting the fixture box shown in Figure 14. Loosen the six bolts shown in Figure 14, and adjust as needed. If there is still an issue with column spacing, the DS-25 motor position may need to be adjusted as well.



Note: A total of six bolts are used to mount the fixture box to the fixture table. Two bolts are located towards the DS-10 motor (A). Two bolts are located within the fixture box (B). Two bolts are located towards the DS-25 motor (C).

Figure 14: Adjusting the Fixture Box to Align Column

First, connect the column output shaft to the DS-25 motor; shown in Figure 15. Afterwards, connect the column input shaft to the DS-10 motor, this drives the steering input through a precision torque transducer, torsional spring, precision angular encoder, and the variable inertia wheel assembly; shown in Figure 16.

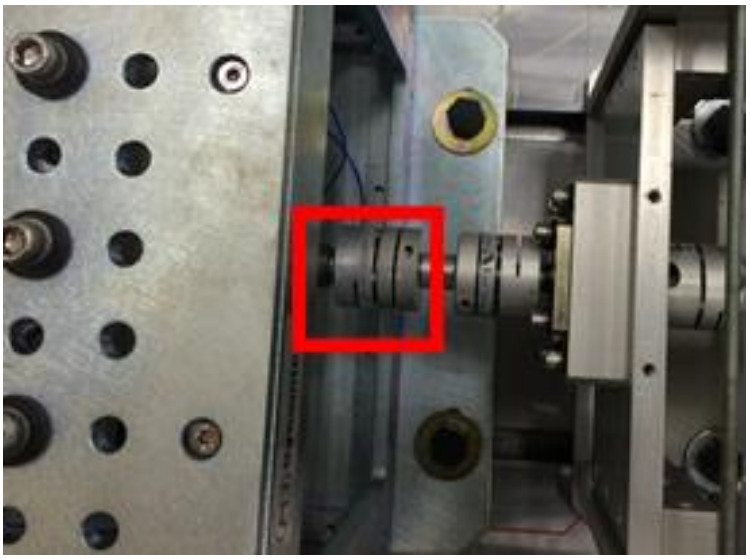


Figure 15: Steering Column Output Shaft Mounted to DS-25 Motor

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