Bulletin 308

PARTS LIST
and
OPERATING PROCEDURE
for
SKIDMORE-WILHELM

MODEL MS

BOLT TENSION CALIBRATOR

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Rev 9/98

SKIDMORE-WILHELM MODEL MS BOLT TENSION CALIBRATOR

The Skidmore-Wilhelm Model MS Bolt Tension Calibrator is designed for calibrating impact wrenches (and other types of installation tools) and testing shorter grip-length, high-strength fasteners. Each calibrator is essentially a hydraulic load cell with a hole in the center for inserting a sample bolt, nut and washer. As the bolt and nut are tightened, they compress the load cell, creating internal hydraulic pressure. A gage measures the pressure and provides a dial readout calibrated in pounds-tension equivalent to the tension created in the fastener.

OPERATING INSTRUCTIONS FOR CALIBRATING IMPACT WRENCHES AND OTHER INSTALLATION TOOLS WITH THE MODEL MS

Basic Calibrator Setup

a. Clamp the calibrator on a convenient beam or column using the two wing screws. Do not over tighten. Excessive force can damage the body.

b. Select a sample bolt for the wrench calibration test. Attach plate (item 5) appropriately sized for the bolt to the front of the calibrator using four cap screws (item 16). Any time you change to a different size bolt for the test, you will need to change the plate as well.

c. Insert the bolt bushing (item 6), either round or hex head, into the back of the calibrator. The bushing fits over the back of the two dowel pins and is held in place with the bushing retainer (item 15).

d. Insert the bolt from the back of the calibrator so that it fits into the bushing. From the front side of the calibrator, first place a hardened washer over the bolt, then tighten the nut so it is snug against the plate. The hardened washer prevents the nut from galling the plate.

e. The bolt can be tightened with an impact wrench, hand torque wrench or other installation tool.

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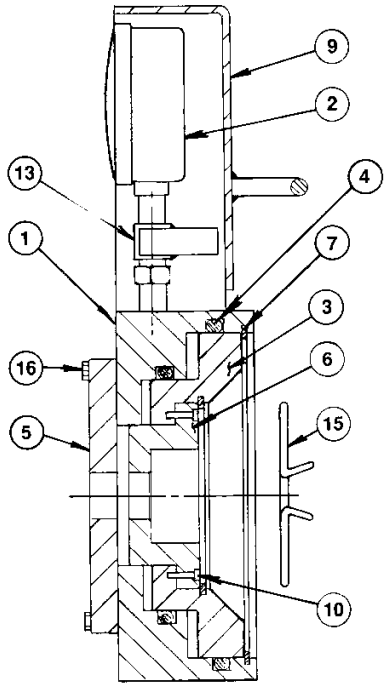

Parts List

Item	Part No.	Name
1	MS-001	Body
2	MS-002	90,000# gage (42,000 kg)
3	MS-003	Piston
4	MS-004	Packing
5	MS-500	Bolt plate
6	MS-600	Round Head bolt bushing
	MS-700	Heavy hex bolt bushing
	When ordering parts MS-500 and MS-700, specify size: 5/8, 3/4, 7/8, 1, 1-1/8, 1-1/4 inches. Metric equivalents available at no extra cost.	
7	MS-007	Snap ring
8	M-008	Mounting screw (not shown)
9	M-009	Gage guard
10	M-010	Bushing dowel pin
13	M--013	Gage saver
15	MS-015	Bushing retainer
16	M-016	1" plate screw

Test Procedures

Based on methods recommended by the Research Council on Structural Connections

Following are descriptions of the fastener installation methods acceptable to the Research Council on Structural Connections. We have listed the appropriate procedures for using each method to calibrate your wrenches.

Perform your selected test procedure at least three times. Each time use a new fastener, but be sure all three are identical in grade, length and diameter. The fasteners must be chosen from among those you intend to use in the actual bolted connection.

Note on Minimum Bolt Lengths:

The Model MS provides a grip length as short as 1-1/8" for bolts with the following specifications:

Bolt Diameter	**Minimum Bolt Length**
5/8" or 3/4"	2.00"
7/8"	2.25"
1"	2.50"
1-1/8"	3.25"
1-1/4"	3.38"

1. CALIBRATED WRENCH METHOD

Calibrated wrenches may be used to achieve minimum bolt tension provided the wrenches are checked **on a daily basis** in a tension measuring device for consistent tightening performance. Furthermore, a hardened washer must be used under the part of the fastener that turns during tightening.

Procedure:

a. Insert the bolt, hardened washer and nut as described in the Basic Calibrator Setup.

b. Tighten the nut with the wrench to be calibrated.

c. Adjust the torque control mechanism or the air pressure up or down so that the reading on the calibrator dial is at least 5% greater than the minimum tension required for the size of the fastener. Minimum fastener tension requirements for A325 and A490 fasteners, as specified by the Research Council on Structural Connections, are printed on the gage dial.

2. ALTERNATE DESIGN BOLTS (TENSION-CONTROL BOLTS)

Tension control bolts are fasteners that undergo a physical change at installation, such as the shearing off of a splined end. Although these bolts may require special installation tools, they can be tested in the calibrator in the same manner as standard bolts. Some tension control bolts have a round head instead of a hex head. Special adapters are available from the factory for these bolts. Testing sample bolts will ensure that the installation tools and fasteners are performing to their manufacturer's specifications.

Procedure:

a. Install the special bushing available from Skidmore-Wilhelm for use with tension-control bolts. Use the same plate you would use for regular hex head bolts. Also install any special hardened flat washers used in the actual joint.

b. Tighten the tension-control bolt according to the manufacturer's installation procedures until twist-off. The reading on the calibrator dial should be at least 5% greater than the minimum tension required.

3. DIRECT TENSION INDICATORS (DTI's)

Load indicating washers or DTI's can be used in the calibrator and checked to see that they are performing properly. Special bushings that allow a socket to be placed on the nut are available for those bolts where the washer is placed under the bolt head. These bushings replace the normal bushings used to prevent bolt head rotation.

Procedure:

a. Install the bolt with the load indicating washer under the bolt head and any special hardened flat washers used in the actual joint through the front plate. Installing the bolt from the front allows a feeler gage to be used to check the washer.

b. From the back of the calibrator install the nut onto the bolt along with any special hardened flat washers used in the actual joint.

c. Tighten the fastener assembly according to the device manufacturer's installation procedures until the washer indicates the proper tension. Tightening the assembly will require two (2) wrenches, one wrench to tighten the nut from the back and the second wrench to prevent the bolt head from rotating.

d. Compare the tension reading on the calibrator gage to the minimum tension required. The reading should be at least 5% greater.

4. TURN-OF-THE-NUT METHOD

This procedure is based on rotating the nut a specified fraction of a turn from a "snug" position. Its effectiveness depends upon the uniformity of the point from which turns are measured. Testing bolts from each lot in the calibrator will help to develop a consistent snug position. Once a snug position is obtained, continue tightening the bolt and check the tension reading after the proper rotation. There is a rotational tolerance of plus or minus 30 degrees, and the effect upon bolt tension can be observed.

Procedure:

a. Tighten the nut to a snug-tight condition.

b. Tighten further by the permitted amount of rotation based on bolt length/diameter relationship (See the related table in the Research Council Specification).

c. Compare the tension reading on the calibrator dial to the minimum tension required. The reading should be at least 5% greater.

5. ROTATIONAL CAPACITY

Rotational capacity tests can be run using the same basic procedures described above in conjunction with the appropriate specification. Please note that bolts and nuts with unusually high friction may require considerably more torque than usual. Care must be taken to avoid shearing the dowel pins.

How To Establish A Job Inspecting Torque For Inspection Arbitration

With a Skidmore-Wilhelm Bolt Tension Calibrator and a manual torque wrench, you can easily determine an inspection torque for testing the tension of bolts already installed.

In the Bolt Tension Calibrator, tighten three representative fasteners to 15% of their required tension to establish an initial condition. The surface under the part that turns should simulate the surface conditions of the actual job. Finish tightening the bolt by any means to the required bolt tension. However, nut rotation during the final tightening cannot exceed 1-1/2 times the rotation permitted by specifications. Then apply enough torque with the job inspection wrench to turn the nut at least 5 degrees **in the tightening direction**. The average torque for the three tests is the job inspecting torque.

Using the calibrated torque wrench, test at least 10 percent of the installed bolts, but not less than two. The job inspecting torque should not turn any of the nuts or bolts. If it does, all fasteners must be retightened and reinspected.

Troubleshooting Suggestions

1. If you are not satisfied with any test results (for example, if readings are widely scattered), check the following:

    a. Make sure you are using a hardened washer.

    b. Make sure each bolt is properly marked A325 or A490.

    c. Make sure that the bolts are not completely dry. On most bolts the rust preventative is sufficient lubrication. However, if the bolts are completely dry, there is a tendency for the threads to seize before the bolt gets up to tension. A small amount of oil on all bolts, both test and installation bolts, will correct this situation.

2. Use a new bolt, nut, and washer for each test, since used nuts and bolts frequently give erratic calibration results. Also, the values marked on the gage dial are minimum bolt tension as approved by the Research Council on Structural Connections and endorsed by the AISC. It is recommended that the wrench be set to induce bolt tension 5% to 10% in excess of these values.

3. Daily rechecks on wrench calibration should be made. This should be done at the job site using the same length of hose and connections that will be used on the job. In this way, calibrating conditions will be identical with job conditions.

ADDITIONAL INSTRUCTIONS FOR TENSION CONTROL BOLTS

Typically, the bolts, nuts, and washers are packaged as a calibrated assembly, so testing must be in strict accordance with the manufacturer's specifications. Lubrication of the components is a key element of the specifications. Verify that the correct lubrication has been used before testing.

If the bolts do not twist off according to specification, check the following:

1. Verify that the correct lubrication has been used.

2. Friction between the bolt head and the calibrator bushing should be great enough to prevent rotation of the bolt during the tightening. If the bolt turns, remove excessive oil or grease from the mating surfaces. It may be necessary to roughen the surface of the bushing.

3. If the bolts are being tested above the AISC tension requirements, thicker plates may be needed. They are available from the factory. Refer to Bulletin 308-1 for more information

Adapters for Model MS Bolt Tension Calibrator

BOLT SIZE	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4

PLATE Part No.	MS-508	MS-510	MS-512	MS-514	MS-516	MS-518	MS-520
BUSHING for Tension Control Bolts - Part No.	MS-608	MS-610	MS-612	MS-614	MS-616	MS-618	MS-620
BUSHING for Heavy Hex Bolts - Part No.	MS-708	MS-710	MS-712	MS-714	MS-716	MS-718	MS-720

Use this list for ordering additional or replacement parts.
When ordering adapters, specify bolt size, head shape (round or heavy hex, and serial number of calibrator.
Special adapters can be made to your specifications upon request.

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MAINTENANCE MANUAL
for
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1. Verifying calibrator accuracy.

You can verify the accuracy of the calibrator gage by placing the unit in a compression press, applying a **known** load through the center, and comparing the known load to the dial reading on the gage.

Place the calibrator in the press on a special fixture or adapter so that the load can be applied through the center of the calibrator. The unit should lie flat, gage facing up. You can put one or more bolt plates on the face of the calibrator to apply the test load.

IMPORTANT: The calibrator bolt plate (item 5) must be thick enough to take the highest test load. Contact Skidmore-Wilhelm to obtain the proper test plate and adapter.

2. Adjusting the gage.

During a calibrator accuracy test, compare the gage reading to the applied load at a number of different points. If the gage is off by the same small increment at each point, adjust it as follows:

a. For gages with a face "Recalibration Screw"

1) Remove the gage lens.

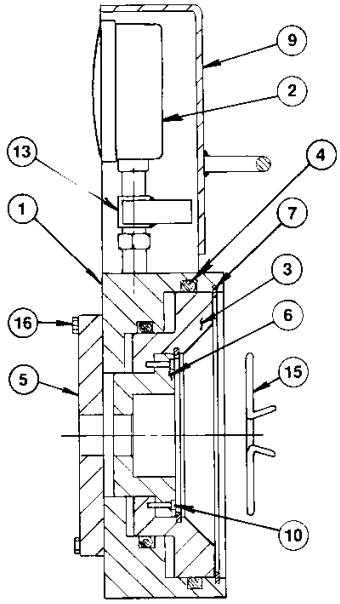
2) Place a small screwdriver into the slot of the recalibration screw and turn the screw right or left (as necessary) so that the pointer moves by the amount of the error.

b. For gages with a "micrometer" style pointer:

1) Remove the gage lens.

2) With one hand, carefully hold the pointer.

3) Insert a screwdriver into the slot in the top of the gear that adjusts the pointer. Turn the screw right or left to move the pointer by the amount of the error.



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7	MS-007	Snap ring
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3. Determining the need for gage repair or replacement.

Sometimes during a calibrator accuracy test, when you compare the gage reading to the applied load at various points, the gage will be off by varying increments rather than by the same increment at each point. Adjusting the gage as described in procedure 2 will not correct this condition. In such cases, Skidmore-Wilhelm does not recommend attempting to adjust or repair the gage in the field. Instead, the gage should be replaced or returned to the factory for repair.

IMPORTANT: Calibrate the gage and calibrator as a unit.

You may replace the gage yourself following procedure 7 below. However, the gage and the calibrator will not be in calibration **as a unit.** Replacement gages are not shipped with a calibration Test Report.

If you cannot calibrate the gage and calibrator unit in a compression press or if you do not have access to a test laboratory capable of performing the test for you, your unit cannot be considered in calibration. Therefore, if your gage needs repair we recommend that you send the entire unit--gage and calibrator--back to us. We will repair or replace the gage, test the entire unit and send it back to you along with a new Test Report.

4. Determining whether the calibrator oil level is low.

Either of two symptoms usually indicates your calibrator is low on oil:

- A noticeable gap appears between the piston and the snap ring when no load is applied to the calibrator.
- The calibrator operates to a reading short of its maximum, then the piston bottoms out against the body. No higher reading or compression of the unit is possible.

To check oil level, do the following:

a. Turn the calibrator on its side so that the 1/4" pipe plug is at the 12 o'clock position.

b. Remove the pipe plug and look into the opening. If the oil level is not at the top of the opening, add oil. See procedure 5.

5. Adding hydraulic oil to the calibrator - gage in place.

a. Repeat procedure 4 above, if necessary.

b. Add hydraulic oil through the pipe plug opening until oil flows out the top of the opening. Use oil that is Buna-N compatible.

c. Work the calibrator piston back and forth to force out trapped air. Add more oil as needed.

d. When all air has been forced out and the oil level is at the top of the pipe plug opening, replace the plug. Use pipe thread tape or pipe dope on the plug threads.

e. If air still remains in the system, you will have to remove the gage to get all the air out. See procedure 9, below.

f. Calibrate the gage and calibrator as a unit.

6. Determining the cause of low oil level.

Low oil level usually means a leak somewhere in the calibrator. Visually inspect the following as the source of the leak:

- Pipe plug is loose or its threads are damaged. Tighten or replace.
- Gage is loose, its threads are damaged or it has internal leakage. Tighten or replace.
- Gage saver is loose, threads are damaged or has a break. Tighten or replace.
- Calibrator packing is worn or damaged and needs replacement.

You may need to replace pipe thread tape or pipe dope to remedy leaks around plug, gage or gage saver threads.

7. Replacing the gage.

a. Remove the gage guard.

b. Select a small shim and position it between the two metal blocks that are part of the gage saver. Then tighten a C-clamp around the gage saver blocks and the shim.

c. Using the C-clamp as a handle to hold the gage saver stationary, unscrew the gage and remove it.

d. Look down into the gage saver and check that it is full of oil. If it is not full, add hydraulic oil according to the steps in procedure 9.

e. Apply pipe thread tape or pipe dope to the gage threads, then screw the new gage onto the gage saver. Hold the gage saver stationary with the C-clamp to tighten the gage. The new gage has oil; you need not add oil to it.

f. Calibrate the gage and calibrator as a unit and reattach the gage guard.

8. Replacing the gage saver.

a. Remove the gage guard and gage as in steps 7a-7c. Invert the gage so that it does not lose its oil.

b. Remove the old gage saver using the proper-sized wrench.

c. Apply pipe thread tape or pipe dope to the threaded end of the new gage saver.

d. Fill the new gage saver with hydraulic oil (Buna-N compatible).

e. Hold the gage saver so that the oil does not run out and thread it into the vacant port. Tighten with a wrench.

f. Shim the gage saver blocks and attach a C-clamp as you did before. Apply pipe thread tape or pipe dope to the gage threads. Hold the gage saver stationary with the C-clamp and replace the gage. Tighten to assure a leak-proof connection.

g. Calibrate the gage and calibrator as a unit and reattach the gage guard.

9. Adding oil to the calibrator when the gage or gage saver is removed.

Note: *Any time oil is added to the calibrator, air trapped inside must be removed. The oil will force the air out, but it must flow from the pipe plug opening in the side, up through the calibrator and out the top. Therefore, when adding oil be sure the unit is in an upright position with the gage opening at the top.*

a. Push the piston all the way out against the snap ring.

b. Remove the 1/4" pipe plug on the side of the unit.

c. Add hydraulic oil through the pipe plug opening until oil comes out the gage saver (if only the gage is removed) or out the hole at the top of the calibrator (if both the gage and gage saver are removed). Use oil that is Buna-N compatible.

d. Reassemble the gage saver and gage as in procedure 8. Be sure the gage saver is full of oil.

e. Calibrate the gage and calibrator as a unit and reattach the gage guard.

10. Replacing the calibrator packing (O-rings).

Note: *You can buy replacement O-rings in standard sizes locally if you wish or you can order them from Skidmore-Wilhelm. When ordering from us, specify the serial number from the tag permanently attached to your calibrator.*

a. Remove the gage guard, gage and gage saver as in procedures 7 and 8.

b. Remove the pipe plug if it is not already out.

c. Drain the oil from the calibrator.

d. Remove the snap ring and the piston.

e. Remove the old O-rings and replace with new O-rings. Wipe them with a small amount of hydraulic oil to ease reassembly.

f. Reassemble the piston and calibrator body. Tap the piston lightly to avoid cutting the O-rings.

g. Push the piston all the way back into the body.

h. Refill with hydraulic oil through the 1/4" pipe plug opening on the side until oil runs out the gage saver hole at the top.

i. Reassemble the gage saver and gage.

j. Add oil as in procedure 9.

k. Calibrate the gage and calibrator as a unit and reattach the gage guard.

11. Adding oil to calibrators having a low-range gage and a high-range gage.

This procedure assumes that both gages are removed but both gage savers are in place.

a. Check the oil level in the low-range gage saver first. This is the gage saver fitted with a shutoff valve.

b. As you begin to add oil through the pipe plug hole on the side of the calibrator, open the shutoff valve. This allows oil to rise into the gage saver.

c. When the lower gage saver is full, close the shut-off valve. Then add oil through the pipe plug hole on the side until oil runs out of the high-range gage saver.

d. Reattach the gages as described above.

e. Calibrate the gage and calibrator as a unit.

12. Replacing dowel pins for the bolt bushing. (See figure on page1.)

Two hardened and ground dowel pins (item 10) fit into the back of the piston (item 3). They locate the bushing (item 6) and hold the bolt stationary while the nut is turned. Occasionally, the pins break if overloaded. Normally breakage of pins does not affect calibration.

Note: *We manufacture the M-010 dowel pins to our specifications. You can buy them directly from us. However, quality hardened and ground pins measuring .250" x .875" can often be obtained locally.*

Replace broken pins as follows:

a. Remove the bushing (item 6) and the bolt plate (item 5).

b. Knock the damaged pins out from the front of the calibrator.

c. Tap in the new pins until seated.