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The MSI Adjustable Choke is used in high-pressure and high flow well service applications. High pressure equipment, if not used and maintained properly, can cause serious injury or death and damage to equipment and property. Not taking proper precautions and failing to perform routine maintenance and inspections can also contribute to loss of well control, and such loss could cause serious injury or death and damage to equipment and property.

The MSI adjustable choke is designed to decrease pressure in a fluid flow situation, as a result, the velocity of the fluid stream increases drastically. Abrasive particles in the high velocity flow stream can cause excessive and premature erosion to the choke components. The downstream side of the choke though is protected by long wearing carbide thus reducing this wear. Therefore it is critical for safety and performance to ensure the choke is installed such that the direction of flow is away from the bonnet on adjustable chokes. Improperly flowing through the choke may cause damage and void the warranty. It is not recommended.

**ALL OPERATORS AND MAINTENANCE PERSONNEL SHOULD BE THOROUGHLY TRAINED IN THE SAFE OPERATION, MAINTENANCE, AND INSPECTION OF THIS EQUIPMENT.**

This product is not designed to be used for fully stopping the flow of fluids. In systems where this is required proper isolation valves should be used in conjunction with the choke.
FLUID DIRECTION THROUGH CHOKE

3/4" & 1" MAXIMUM ORIFICE (2" IRON)    2" MAXIMUM ORIFICE (3" IRON)
2.1 **Choke Description**

Adjustable chokes are used in many oilfield applications to control the rate of flow. Usually an adjustable choke is used as part of a manifold installed downstream of the wellhead. The choke is adjusted during flowback of the well to control downstream pressure and flow rates. The MSI adjustable choke is comprised of three main sub-assemblies. These sub-assemblies are the bonnet, tee, and nipple assemblies (for 2” iron only).

2.2 **Choke Specifications**

MSI chokes are available in ¾”, 1”, and 2” maximum orifice sizes. The components that comprise the choke are made from various materials. The bonnet, tee, and nipple are made from forged alloy steel. The stem is manufactured from stainless steel and utilizes a solid carbide tip. The choke seat is also made from stainless steel that has been fitted with a carbide liner.
CHOKE MAIN SUB-ASSEMBLIES

3/4" & 1" MAXIMUM ORIFICE (2" IRON)

2" MAXIMUM ORIFICE (3" IRON)

BONNET ASSEMBLY

TEE ASSEMBLY

NIPPLE ASSEMBLY
3.1  **Exploded View**

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**3" Manual Choke Bonnet Standard Service H2S Service**

**No Description**

1. 3" Manual Choke Bonnet
2. Manual Choke Bonnet
3. Wingseal™ Bonnet

**Inventory**

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4.1 **Choke Adjustment**

The equivalent orifice size of MSI manually operated chokes can be easily determined, adjusted, and set. To adjust the choke, loosen the thumbscrew, **BUT DO NOT REMOVE**. Once you have loosened the thumbscrew, turn the hand wheel either clockwise to throttle the choke closed, or counter-clockwise to throttle the choke open. Once the desired rate is achieved tighten the thumbscrew, to lock down the stem at the desired setting. All MSI manually adjustable chokes come with an indicator. Each number on the indicator represents the equivalent orifice diameter in 1/64ths of an inch. Determining the flow bean size needed for a positive choke can be determined by reading the number shown on the indicator at the indicator line located on the bonnet extension. The orifice size can be determined by using orifice indicator bean sizing table, or you can multiply the indicator number by 1/64 and that will give you the orifice size for the flow bean needed.

Example below the indicator is at 42 this would be equivalent to an orifice bean size of 42/64.
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</table>
5.1 Preventative

The choke stem will periodically need to be lubricated. Using the choke assembly grease fitting, inject a few strokes of general purpose grease.

Legacy 3” choke assemblies do not have a grease fitting. In this case, to lubricate the stem, first ensure there is no pressure in the system. Rotate the hand wheel counter clock-wise until it is fully open. Remove the hand wheel, indicator, and bonnet extension. There should be approximately 3 inches of threads exposed. Apply a liberal amount of general purpose grease. Replace bonnet extension, indicator, and hand wheel. Turn hand wheel clock-wise until the choke is fully shut. To calibrate the indicator, refer to steps 5-11 in Section 5.5 for assembly directions (as applicable) or to Section 5.8.4 for the adjustable choke stem synchronization procedure.

5.2 Disassembly

1. Bleed off any pressure from the choke assembly.
2. Loosen thumbscrew and turn hand wheel counter-clockwise to disengage the tip of the stem from the seat.
3. Loosen the wingnut and disconnect the bonnet assembly from the choke tee assembly.
4. Remove the seat from the choke tee assembly using an appropriate choke seat wrench.
5. Remove the hand wheel by removing the hex nut and washer. Use a 15/16” wrench.
6. Loosen the setscrew in the indicator using a 5/32” hex key and slide the indicator off the stem.
7. Remove the stem by grasping it by the carbide-tipped end and rotating counter-clockwise until the threads disengage the bonnet thread bushing. NOTE: DO NOT USE ANY PLIERS, WRENCHES ON THE SEALING SURFACE OF THE STEM. DAMAGE WILL OCCUR! THE HANDWHEEL MAY BE USED TO LOOSEN THE STEM.
8. Remove the snap-ring or spiral retaining ring. Then remove the packing retainer, packing, and stem guide. NOTE: The packing retainer and stem guide only apply to chokes with 2” connections.
9. As needed: The thread bushing may be removed for inspection or replacement. Using a 3/16” hex key remove the two socket-head stay bolts, lock washers, and bonnet extension. Unscrew the thread bushing. If the thread bushing is tight use a 1-5/8” combination wrench or an adjustable wrench.
10. As needed: Remove the thumbscrew so that the wingnut may be removed if necessary. Loosely replace thumbscrew, so as not to lose the stem stay ball.
11. Remove the bonnet o-ring and bonnet back up ring. NOTE: This is only applicable to chokes bonnets with 3” 1502 connections.
12. Degrease and clean all parts

5.3 Inspection

After degreasing the parts, visually inspect for abnormal wear, corrosion, erosion, or any other physical damage.

1. Inspect the threads, packing area, shaft and carbide tip of the stem and replace as necessary. The cone of the carbide tip should be smooth and without grooves or cracks.
2. Inspect the threads and carbide liner of the seat and replace as necessary. The entry bevel of the carbide liner should be smooth and without grooves or cracks. Look down the orifice for washouts in the mid-section of the liner.
3. Always discard the packing when removed from the bonnet. Replace with new packing.
4. Replace the wingnut if the lugs are excessively deformed or damaged.

5.4 2” Choke Assembly (Rebuilt)

Note - Always use high quality graphite grease or anti-seize during assembly. Lubricate all parts thoroughly, especially threads.

1. **If previously removed:** Apply anti-seize to the internal and external threads on the bushing. Screw the thread bushing clock-wise into the bonnet. Attach the bonnet extension using the two socket-head stay bolts and lock washers (10 ft-lbs).

2. Apply light general purpose grease in the packing gland of the bonnet

3. Apply light general purpose grease to the choke stem threads and sealing surface. Install the following items **on the stem** in this order:
   a. Packing retainer.
   b. Packing set. The "V" of the chevron segments should face outward away from the hand wheel.
   c. Stem guide.
   d. Apply light general purpose grease to the outside of the packing.

4. Insert the threaded end of the stem (along with previously installed packing) into the bonnet and carefully push straight in until the threads of the stem meet and engage the threads of the bonnet. Rotate the stem clockwise until the packing is fully seated on the bonnet. Install spiral retaining ring.

5. **If previously removed:** Once again remove the thumbscrew. Slide the wingnut onto the bonnet body, and loosely re-attach the thumbscrew, so as not to lose the stem stay ball. Use anti-seize on threads.

6. Slide the choke indicator onto the stem with "zero" end away from the bonnet, do not tighten set screw.

7. Attach the hand-wheel, washer, and hex nut onto the stem. Temporarily position the indicator up against the hand wheel and tighten set screw.

8. Apply anti-seize to the internal threads on the male end connection of the choke tee. If needed, temporarily remove choke nipple assembly and reinstall once done.

9. Apply anti-seize to threads of choke seat. Using an appropriate choke wrench install the seat by rotating clockwise into the choke tee assembly and tighten to approximately 100 ft-lbs.

10. Mount the bonnet assembly to the choke tee assembly and make up the union properly. Crank the hand-wheel clockwise until the stem bottoms out firmly into the choke seat. This is the full closed position.

11. Loosen the indicator set screw, and line up the "zero" calibration of the indicator with the indicator groove on the end of the bonnet extension and tighten the indicator setscrew. **Note-This step is required whenever the bonnet assembly has been disengaged from the tee assembly.**

12. Grease the bonnet using the grease fitting on the side of the bonnet.

13. Back the stem off the choke seat and tighten the thumbscrew for transport in the open position.
5.5  3” Choke Assembly (Rebuilt)

Note - Always use high quality graphite grease or anti-seize during assembly. Lubricate all parts thoroughly, especially threads.

1. **If previously removed:** Apply anti-seize to the internal and external threads on the bushing. Screw the thread bushing clock-wise into the bonnet. Attach the bonnet extension using the two socket-head stay bolts and lock washers (10 ft-lbs).

2. Apply light general purpose grease to the packing gland of the bonnet, and install the following in order:
   a. Install first packing retainer.
   b. Install choke packing bushing.
   c. Install new U-packing on bonnet gland. The flat face of the packing should face outward (away from the hand wheel).
   d. Install second choke packing retainer.
   e. Install choke packing spiral retaining ring.
   f. Apply light general purpose grease to the inside of the packing.
   g. Apply grease to the bonnet o-ring and back up ring and install in bonnet groove.

3. Lubricate the choke stem with general purpose grease. Insert the threaded end of the stem into the bonnet and carefully push straight in until the threads of the stem meet and engage the threads of the bonnet. Rotate the stem clockwise until the safety shoulder of the stem makes contact with the packing retainer. *NOTE: Due to friction between U-packing and stem, it might be necessary to use the hand wheel temporarily to turn the stem.*

4. **If previously removed:** Once again remove the thumbscrew. Slide the wingnut onto the bonnet body, and loosely re-attach the thumbscrew, so as not to lose the stem stay ball. Use anti-seize on threads.

5. Slide the choke indicator onto the stem with "zero" end away from the bonnet, do not tighten set screw.

6. Attach the hand-wheel, washer, and hex nut onto the stem. Temporarily position the indicator up against the hand wheel and tighten set screw.

7. Apply anti-seize to the internal threads on the male end connection of the choke tee.

8. Apply anti-seize to threads of choke seat. Using an appropriate choke wrench install the seat by rotating clockwise into the choke tee assembly and tighten to approximately 125 ft-lbs.

9. Mount the bonnet assembly to the choke tee assembly and make up the union properly. Crank the hand-wheel clockwise until the stem bottoms out firmly into the choke seat. This is the full closed position.

10. Loosen the indicator set screw, and line up the "zero" calibration of the indicator with the indicator groove on the end of the bonnet extension and tighten the indicator setscrew. *Note - This step is required whenever the bonnet assembly has been disengaged from the tee assembly.*

11. Grease the bonnet using the grease fitting on the side of the bonnet.

12. Back the stem off the choke seat and tighten the thumbscrew for transport in the open position.
5.6  Pictorial Disassembly

**WARNING: BLEED OFF ANY PRESSURE FROM CHOKE ASSEMBLY BEFORE**

Loosen the thumbscrew. Don’t remove at this time.

Rotate hand wheel counter clockwise to ensure the stem is disengaged from the seat.

Loosen wing nut and remove bonnet assembly from tee assembly.
Remove the seat from the choke tee assembly using an appropriate choke seat wrench.

Using a 15/16” wrench or socket, remove the hand wheel by removing the hex nut and washer.

Using a 5/32” hex key, loosen the indicator setscrew.
Slide the indicator off the stem.

Remove the stem by grasping it by the carbide-tipped end and rotating counter-clockwise until the threads disengage the bonnet thread bushing.

**WARNING: DO NOT USE ANY PLIERS, WRENCHES ON THE SEALING SURFACE OF THE STEM. DAMAGE WILL OCCUR!**

Remove the snap-ring or spiral retaining ring.
Remove the packing retainer. Applies only to chokes with 2” connections.

Remove packing.

**NOTE: THE PACKING IS NOT INTENDED TO BE RE-USED AFTER REMOVED FROM BONNET. ALWAYS REBUILD WITH NEW PACKING**

Remove stem guide. Applies only to chokes with 2” connections.
As needed: The thread bushing may be removed for inspection or replacement.

Loosen socket-head stay bolts with a 3/16” hex key.

Remove the stay bolt and lock washer.

Remove bonnet extension.
Unscrew the thread bushing. **NOTE:** If the bushing is too tight use an adjustable wrench or a 1 5/8” open end wrench.

If the wingnut needs replacement:

Remove the thumbscrew. Do not lose stem stay ball, as it might come out.

Remove the wingnut.

**NOTE:** Loosely replace the thumbscrew to keep from losing the stem stay ball.
5.7 **Pictorial Inspection**

Clean and degrease the parts, and visually inspect for abnormal wear, corrosion, erosion, or other physical damage.

Inspect the stem threads. If there is abnormal wear on the threads (such as a step on the thread flank), replace the stem.

If there are any burrs or nicks present, these need to be removed.

Inspect stem packing sealing surface and shaft.

Sealing surface should be free of scratches or imperfections. Lightly buff out any light scratches to improve sealing surface finish.

If there is any wear on the sealing surface, replace the stem.

Inspect the carbide tip of the stem. The cone of the carbide tip should be smooth and without grooves or cracks.

The brazing between carbide tip and stem should be free of cracks or pits.

**NOTE:** THE STEP DEPICTED ON IMAGE HAS CRACKS ON BRAZING. THIS NEEDS TO BE REPLACED.

Replace stem as necessary
Inspect the threads of the seat for any damage. Any burrs or nicks should be removed to prevent galling with fitting internal threads if reused.

Inspect the entry bevel of the carbide liner. It should be smooth and without grooves or cracks.

NOTE: THE SEAT DEPICTED ON IMAGES SHOWS CRACKING AND IS CHIPPED. THIS NEEDS TO BE REPLACED.

Look down the orifice for washouts in the mid-section of the liner.

Replace seat as necessary
Inspect the bonnet sealing surface and packing gland sealing surface.

Buff any light scratches or surface imperfections to improve sealing surface finish.

Replace bonnet as necessary.

Inspect wing nut for excess wear and damage.

Replace if severe damage is present.

Remove any nicks or burrs on threads if present.

**WARNING:** WING NUT DEPICTED AT RIGHT AND BOTTOM IS BEYOND SERVICEABLE LIFE AND IS A SAFETY HAZARD. IT SHOULD BE REPLACED.
5.8 Pictorial Assembly

5.8.1. Assembling the Tee subassembly

NOTE - ALWAYS USE HIGH QUALITY GRAPHITE GREASE OR ANTISEIZE DURING ASSEMBLY. LUBRICATE ALL PARTS THOROUGHLY, ESPECIALLY THREADS.

Lubricate resilient seal gland on female connection (light general purpose grease)

Install resilient seal on gland
Install spiral retaining ring over male end

For a 3” choke assembly only: Ensure that the spiral retaining ring is over the step on the outer diameter of the male end (see image).

If this is not done, it will be very difficult to install the retainer segment set.

Slide the wingnut over the male end connection
Install the nut retainer segment set.

If the spiral retaining ring was correctly installed over the male end outer diameter step, there should be plenty of space to install the 3rd segment.

Align all three segments behind wingnut until the ring groove is aligned and accessible.
Install spiral retaining ring on the ring groove on all three segments.

Apply a liberal amount of anti-seize to the internal threads on male end connection

**For a 2” choke assembly only:** assemble the choke nipple subassembly:

- lubricate sealing gland with light general purpose grease and install resilient seal
- slide spiral retaining ring and wingnut over male end connection
- insert nut retainer set into wingnut
- install spiral retaining ring on the ring groove on all three segments.
For a 2” choke assembly only: assemble the choke nipple with the choke tee subassembly:

Lubricate (with anti-seize) the choke seat threads thoroughly.

Using the appropriate choke seat wrench, insert the choke seat through the female end connection of the Tee fitting.
Using a torque wrench, fully tighten the choke seat to the recommended torque below.

<table>
<thead>
<tr>
<th>Choke Size</th>
<th>Torque (ft*lbs)</th>
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</thead>
<tbody>
<tr>
<td>2”</td>
<td>100</td>
</tr>
<tr>
<td>3”</td>
<td>125</td>
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</tbody>
</table>

Tee subassembly is complete.
5.8.2. Assembling the 2” Bonnet subassembly

NOTE - ALWAYS USE HIGH QUALITY GRAPHITE GREASE OR ANTI-SEIZE DURING ASSEMBLY. LUBRICATE ALL PARTS THOROUGHLY, ESPECIALLY THREADS.

Lubricate the thread bushings internal and external threads.

Screw the thread bushing into bonnet and wrench tighten.

NOTE: Prior to installing the bonnet extension onto the bonnet ensure the extension indicator line is on the same side as the thumbscrew tapped hole and grease fitting hole.
Apply anti-seize to the bonnet extension socket head cap screws.

Install lock washers on socket head cap screws and hand start the screws into the bonnet tapped holes.

Tighten the socket head stay bolts to 10 ft-lbs, attaching the bonnet extensions to the bonnet.

Lubricate the packing gland of the bonnet with light general purpose grease.
Lubricate the choke stem with light general purpose grease, to prevent damage to packing during installation.

Install choke packing retainer on stem

Install new packing on choke stem. Verify the correct orientation is used.

Install choke stem guide on stem.
Lubricate outside of choke stem packing with general purpose grease

Insert the threaded end of the stem with packing into the bonnet and engage the threads on the bonnet bushing.

*Note: Thread the choke stem clockwise by hand, until the choke packing is fully seated. Do NOT use tools to turn the stem.*

Install retaining snap ring
Apply 1.5-2 turns of PTFE (Teflon®) tape on grease fitting in clockwise direction (when viewed from grease fitting threaded end)

Install grease fitting on bonnet hand tight

Wrench tighten 2-3 turns from the hand tight position

Never back off (loosen) grease fitting to achieve final alignment.

Slide wing nut onto bonnet body.

Install stem stay ball.

Apply anti-seize to the thumbscrew.
Install thumbscrew on bonnet, but do not tighten at this time.

Slide the indicator onto the stem. Do not tighten set screw.

**NOTE: THE END OF THE INDICATOR WITH THE SET SCREW MUST BE INSTALLED AWAY FROM THE BONNET.**

Install hand wheel, washer, and hex nut.
Temporarily position the indicator up against the hand wheel and tighten set screw.

Using the grease fitting, inject a few strokes of general purpose grease.

2” bonnet assembly is complete
5.8.3. Assembling the 3” Bonnet subassembly

NOTE - ALWAYS USE HIGH QUALITY GRAPHITE GREASE OR ANTI-SEIZE DURING ASSEMBLY. LUBRICATE ALL PARTS THOROUGHLY, ESPECIALLY THREADS.

Lubricate the thread bushings internal and external threads.

Screw the thread bushing into bonnet and wrench tighten.

NOTE: Prior to installing the bonnet extension onto the bonnet, locate indicator line.

Position bonnet extension on bonnet, and align the indicator line with the grease fitting hole on the bonnet. Stay bolt hole should also line up with grease fitting hole.

Apply anti-seize to the bonnet extension socket head cap screws.

Install lock washers on socket head cap screws.
Hand start the screws (with lock washers) into the bonnet tapped holes.

Tighten the socket head stay bolts to 10 ft-lbs, attaching the bonnet extensions to the bonnet.

Lubricate the packing gland of the bonnet with light general purpose grease.
Install first choke packing retainer on bonnet

Install choke packing bushing on bonnet

Install new U-packing on bonnet gland. Verify the correct orientation is used.

**INSERT THIS END ON BONNET FIRST**

*NOTE:* It might be necessary to slightly tap the U-packing in place using a mallet and a drive socket that fits over the packing.
Install second choke packing retainer on bonnet

Install choke packing spiral retaining ring

Lubricate inside of packing with light general purpose grease
Using light general purpose grease, install backup ring on seal gland as shown.

If backup ring has a concave surface, install flat side first as depicted on image above.

Using light general purpose grease, install o-ring on seal gland as shown.

Lubricate the choke stem with light general purpose grease.

Insert the threaded end of the stem through the bonnet and engage the threads on the bonnet bushing. Thread choke stem by hand until resistance is felt.

*NOTE:* Might need to use the hand wheel to gain mechanical advantage and overcome the resistance as the packing is being compressed.
Holding the bonnet in place, temporarily position the hand wheel on the stem and use it to continue threading the stem in place.

Packing friction should easily be overcome.

Stop turning when stem shoulder contacts the bonnet.

Remove hand wheel.

Apply 1.5-2 turns of PTFE (Teflon®) tape on grease fitting in clockwise direction (when viewed from grease fitting threaded end)

Install grease fitting on bonnet hand tight

Wrench tighten 2-3 turns from the hand tight position

Never back off (loosen) grease fitting to achieve final alignment.

Slide wing nut onto bonnet body
Install stem stay ball

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Apply anti-seize to the thumbscrew.

Install thumbscrew on bonnet, but do not tighten at this time.

Slide the indicator onto the stem. Do not tighten set screw.

**NOTE:** THE END OF THE INDICATOR WITH THE SET SCREW MUST BE INSTALLED AWAY FROM THE BONNET.
Install hand wheel, washer, and hex nut.

Temporarily position the indicator up against the hand wheel and tighten set screw.

Using the grease fitting, inject a few strokes of general purpose grease.

3” bonnet assembly is complete
5.8.4. Adjustable choke stem synchronization procedure

Mount the bonnet assembly to the choke tee assembly. Ensure the union connection is properly made up and tight.

Rotate the hand wheel clockwise to shut the choke.

Loosen the indicator set screw. Rotate and slide the indicator into position, so that the “0” is aligned with the indicator groove on the bonnet extension.

Tighten the indicator set screw. Now the choke is zeroed out.

*Note: If done correctly, the choke stem travel should be synchronized to the choke seat position.*
Rotate the hand wheel counter clockwise to unseat the stem from the choke seat. Tighten the thumbscrew to lock the stem into an open position.

This is the stem position to transport the choke.