SPM® Flow Line Safety Restraint System (FSR) Installation Guide
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WARNING

FAILURE TO READ, UNDERSTAND AND FOLLOW THIS INSTRUCTION GUIDE MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

THE USE OF PRESSURIZED COMPONENTS IN OIL FIELD OPERATIONS IS INHERENTLY DANGEROUS. PERSONNEL WORKING AROUND ENERGIZED EQUIPMENT AND FLOW LINES SHOULD USE EXTREME CARE AND OBSERVE ALL APPLICABLE SAFETY PRECAUTIONS.

PROPER USE OF THIS DEVICE CAN REDUCE BUT NOT ELIMINATE THE RISK OF SEVERE PERSONAL INJURY OR DEATH. EVEN WITH SPM® FSRs, SEVERE PERSONAL INJURY OR DEATH CAN RESULT FROM DEBRIS AND SHRAPNEL SHOULD A RUPTURE OCCUR.

THIS IS NOT A LIFTING DEVICE, NOR SHOULD IT BE INSTALLED BY ANYONE OTHER THAN PERSONNEL SPECIFICALLY TRAINED IN WEIR OIL & GAS PROCEDURES.

SAFETY INFORMATION

Important! Read before attempting to use.

• It is critical that, since most SPM® products generate, control or direct pressurized fluids, those who work with these products be thoroughly trained in their proper application and safe handling. It is also critical that these products be used and maintained properly. Any components that show obvious signs of damage or wear should be removed from service immediately.

• SPM® Flow Line Safety Restraint components are not intended for individual use. SPM® FSR Ribs and Spines are not lifting devices and should never be used as such. Any Ribs or Spines that have been subjected to any loads should be immediately taken out of service.
• SPM® FSRs are considered “single-use” items. This means that, while these components can be installed multiple times out in the field, if they are actually employed (that is, subjected to trauma as in the event of a union failing or a pipe rupturing), then the affected FSR components need to be replaced immediately.

• Always keep ALL personnel away from the flow line while under pressure. This applies even when a restraint system such as SPM® FSR is in place.

• Installation of individual SPM® FSR components as well as the system itself should be done by Weir Oil & Gas personnel or persons qualified by Weir Oil & Gas to do so. Training is available from Weir Oil & Gas, contact 1-800-342-7458 for more information.
# DUTY & PRESSURE RATINGS CHART

<table>
<thead>
<tr>
<th>Size &amp; Pressure Ratings</th>
<th>Light Duty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Iron Size</td>
<td>Max Working Pressure (PSI)</td>
</tr>
<tr>
<td>2”</td>
<td>15,000</td>
</tr>
<tr>
<td>3”</td>
<td>7,500</td>
</tr>
<tr>
<td>4”</td>
<td>5,000</td>
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<table>
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<th>Size &amp; Pressure Ratings</th>
<th>Medium Duty</th>
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<tr>
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<td>3”</td>
<td>15,000</td>
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<td>10,000</td>
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<tr>
<td>3”</td>
<td>15,000</td>
</tr>
<tr>
<td>4”</td>
<td>15,000</td>
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</tbody>
</table>

Above pressure ratings are valid for either gas or liquid frac media, and apply to both non-waterproof and waterproof SPM® FSR models.

**NOTE:** SPM® FSR Ribs & Spines are rated for specific duty ratings. Ribs should NEVER be substituted for Spines. Ribs & Spines from different duty ratings should not be mixed.

**NOTE:** SPM’s Medium Duty FSR System is rated for use on 4” treating iron up to 10,000 psi. In instances where the product is required for 4” 1502 lines, a double wrapping technique may be used that will provide acceptable load rating for the flow line. Please contact Weir Oil & Gas Engineering at 1-800-342-7458 for more details regarding the double wrap procedure or if you have further questions.
# DUTY RATING & COLOR CODE CHART

<table>
<thead>
<tr>
<th>Color Codes:</th>
<th>Light Duty</th>
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<tbody>
<tr>
<td>SPM® FSR Ribs</td>
<td>Yellow</td>
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<tr>
<td>SPM® FSR Spines</td>
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<table>
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<th>Medium Duty</th>
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</thead>
<tbody>
<tr>
<td>SPM® FSR Ribs</td>
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<tr>
<td>SPM® FSR Spines</td>
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<table>
<thead>
<tr>
<th>Heavy Duty</th>
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</thead>
<tbody>
<tr>
<td>SPM® FSR Ribs</td>
<td>Orange</td>
</tr>
<tr>
<td>SPM® FSR Spines</td>
<td>Grey</td>
</tr>
</tbody>
</table>
**CHEMICAL COMPATIBILITY CHART**

<table>
<thead>
<tr>
<th>Chemical</th>
<th>FSRs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acids</td>
<td>*See note</td>
</tr>
<tr>
<td>Alcohols</td>
<td>OK</td>
</tr>
<tr>
<td>Strong Alkalis</td>
<td>OK</td>
</tr>
<tr>
<td>Ethers</td>
<td>OK</td>
</tr>
<tr>
<td>Hydro-Carbons</td>
<td>OK</td>
</tr>
<tr>
<td>Ketones</td>
<td>OK</td>
</tr>
<tr>
<td>Oils – Crude</td>
<td>OK</td>
</tr>
<tr>
<td>Oils – Lubricating</td>
<td>OK</td>
</tr>
<tr>
<td>Soaps / Seawater</td>
<td>OK</td>
</tr>
<tr>
<td>Water / Seawater</td>
<td>OK</td>
</tr>
<tr>
<td>Weak Alkalis</td>
<td>OK</td>
</tr>
</tbody>
</table>

*Acid Compatibility – Hydrochloric Acid (HCl): Concentrations up to 36% acceptable for up to 8 hours. Hydrofluoric Acid (HF): Concentrations up to 10% acceptable for up to 8 hours. (Note that all chemical exposures are assumed to be at ambient temperature.)*

For other acids or chemicals not stated, please contact Weir Oil & Gas Engineering at 1-800-342-7458.

**DEFINITIONS**

**Anchor Line** – Anchor lines are similar to main lines; however, instead of being continuously installed along the flow line like main lines, anchor lines are attached to a single point on the flow line, such as an anchor crossover, and run to a properly rated object away from the flow line. (Refer to Securing SPM® FSR System Ends later in this document) Only appropriately rated Spines should ever be used to make up anchor lines. Reference the previous product rating color code chart for more information.
Anchor Crossover Assemblies – Special crossovers, similar to standard integral crossovers, but designed with anchor clamps/shackles that link SPM® FSR main lines together. Anchor crossover assemblies should be installed on either end of a group of swivels/swivel assemblies when using the primary installation method. They are designed to reduce the movement of the swivel assemblies in the event of a failure. Anchor crossovers should also be used as the connection point of the anchor line to the flow line when using the primary method of installation. Reference primary and secondary installation methods found later in this document.

SPM® FSR – Abbreviation for SPM® Flow Line Safety Restraints.

SPM® FSR Rib – SPM® FSR Ribs are engineered synthetic loops that are always 4’ long in Light Duty and Medium Duty, and 5’ long in Heavy Duty. They are designed to be installed at each union connection on a flow line, on swivel elbows, and mid-way through long lengths of pipe. They are looped around the union connection, and then the main SPM® FSR line, comprised of appropriately rated Spines, is threaded through the Ribs in order to create a continuous safety line (main line). Reference the previous product rating color code chart for more information.

SPM® FSR Spine – SPM® FSR Spines are engineered synthetic loops that can range from 4’ to 20’ in length. They make up the main line of the SPM® FSR system as well as the anchor lines. Spines are linked together to create the main line, and then both ends should always be secured to immovable anchor points at each end of the SPM® FSR installation. Reference the previous product rating color code chart for more information. Available in the following lengths: 4’, 6’, 8’, 10’, 15’, and 20’.

Main Line – Comprised of multiple SPM® FSR Spines, this is the safety restraint line that is installed along the flow line. Ribs are looped around the union connection, and then the main line, comprised of appropriately rated Spines, is threaded through the Ribs in order to create a continuous main line. The main line should run perpendicular along side the flow line, never wrapping around it. Reference the previous product rating color code chart for more information.
GENERAL INFORMATION

Note: It is critical that, since most SPM® products generate, control or direct pressurized fluids, those who work with these products be thoroughly trained in their proper application and safe handling. It is also critical that these products be used and maintained properly.

GENERAL:

SPM® FSRs are intended to help contain high-pressure piping and flow line components in case of rupture or excessive impulse during the pumping process. When flow lines fail, whether it is due to excessive pressure, faulty connections, worn components, trauma to the piping connections, or otherwise, the results can be devastating and catastrophic to both equipment and people. The metal components that were previously being subjected to up to 20,000 psi of internal pressure are suddenly and instantly forced to relieve themselves of the stored energy. In a failure there could be hundreds or even thousands of pounds of iron pipe flailing about in an unrestrained condition. In that scenario, there is a high likelihood of severe personal injury or death. SPM® FSRs were designed to reduce, but do not eliminate, that risk.

SPM® FSR is available in two different application configurations: non-waterproof and waterproof. The waterproof version may be desired in applications where increase in weight due to absorption of water from the surrounding environment is a concern. Waterproof and non-waterproof SPM® FSR components are both rated to their listed duty rating.

IDENTIFICATION:

SPM® Safety Restraints are permanently identified on each of the individual components. All metal components have full traceability. The restraint components are identified with their VENDOR ID (Weir SPM), PART NUMBER, SIZE, SERIAL NUMBER and WATERPROOF (if applicable) recorded on the label permanently attached to each restraint. NOTE: If this tag becomes removed from component part or is no longer legible, discard restraint.
CARE:
Maintenance & Storage –
SPM® Safety Restraints generally do not require any special maintenance to keep them in service. Even though they are water resistant, the components should NOT be used underwater or submersed in water. If they are in an environment where they get wet, it is recommended that they are wiped dry after each use with a clean, dry cloth.

It is recommended to store SPM® Safety Restraints and associated equipment in a dry place. However, exposure to water will not reduce the load capacity of the components; it only will make them slightly heavier. *This does not apply to waterproof SPM® FSRs.*

TEMPERATURE RATING (Standard*):
Minimum: -30° C / -22° F
Maximum: 100° C / 212° F
*For higher temperature applications contact Weir Oil & Gas Engineering at 1-800-342-7458.

APPLICATION:
SPM® Safety Restraint assemblies are designed to help reduce the effect of failures on pressure pumping jobs running energized fluid. This system has completed simulated field test at 15,000 psi with nitrogen, utilizing approximately 125 linear feet of 3”- 1502 components, and has effectively performed in multiple flow line ruptures. The SPM® Safety Restraint assemblies are effective when used with either gas or liquid frac media.

Because non-energized systems are considerably less volatile, SPM® FSR will also work with any flow line running non-energized fluids provided they are within the previously mentioned duty rating guidelines.
INSPECTING SPM® FSR COMPONENTS:
Inspect each component before every use. Also, to ensure safety, qualified personnel should inspect the complete installation before every use.

a) SPM® Safety Restraints (Spines & Ribs) –

The SPM® FSR Spines and Ribs are designed so failures are normally visible. If there are any signs of damage, the affected components should be replaced. Remove SPM® Safety Restraints from service if inspection indicates the following damage:

1) Any damage to the SPM® FSR cover where internal red-striped white core yarns are exposed.
   (This includes cuts, holes, tears, snags, abrasions or other damage to cover).

2) The SPM® Safety Restraint ID tag is missing or has become illegible.

3) Knots or other modifications to any part of the SPM® FSR.

4) Melting, charring, or other indications of excessive heat to any part of the SPM® FSR.

5) Acid, caustic burns or other signs of chemical deterioration to the SPM® FSR.

6) Any SPM® FSR that has been stretched beyond its original design length, deformed, or otherwise misshapen, is visually noticeable by the outer cover being frayed and discolored.

7) Any other visible damage which causes doubt as to the strength of the SPM® FSR.

Note: Upon removal, note the serial number for your records, cut the restraint in half, remove the tag, and discard.
b) Anchor Crossover Assembly –

Remove Anchor Crossovers from service if inspection indicates the following damage:

1) Excessive rust or corrosion prevents the crossover from operating properly.

2) Excessive wear on the OD or ID of crossover.

3) Any damage to integral female threads that would prevent proper installation.

c) Anchor-“C”-type & “D”-type Shackles – Remove shackles from service if inspection indicates the following damage:

1) Visible signs of damage or galling on screw threads that would prevent proper operation.

2) The metal shackles show excessive wear.

3) The shackle’s screw pin is damaged and cannot be fully installed into the mating threads.
GENERAL INSTALLATION NOTES FOR SPM® FLOW LINE SAFETY RESTRAINT SYSTEM (FSR)

Installation of individual SPM® FSR components as well as the system itself should be done by Weir Oil & Gas personnel or persons qualified by Weir Oil & Gas to do so. Training is available from Weir Oil & Gas. Contact us at 1-800-342-7458 for more information.

Any misuse of the SPM® FSRs such as lifting or towing, or improper installation shall void any and all warranties and may cause injury or death. Further, any mishandling of the SPM® FSRs such as not following the maintenance and care instructions contained in this guide, including but not limited to exposing the SPM® FSRs to excessive heat, shall void all warranties.

Prior to installation, verify that the tag indicates its recent inspection date. For most efficient setup, install SPM® FSR Ribs and Spines in unison with the flow line rig-up. After SPM® FSR is installed, check every connection, every link, and every SPM® FSR component to ensure that there is a continuous connection from anchor point to anchor point.

• As a note for standardization the annual inspection and tag punch represents when the inspection is done.

After the complete SPM® FSR system is installed, make sure:
  a) All SPM® FSR Ribs are installed as tight as possible around flow line components.
  b) All main line and anchor line SPM® FSR Spines are as tight as possible from anchor point to anchor point.

Always keep ALL personnel away from the flow line while under pressure. This applies whether or not a restraint system is installed.
INSTALLING SPM® FSR COMPONENTS - "RIB" INSTALLATION

STEP 1
Begin by positioning the Rib beneath flow line as shown. The Rib profile should straddle the union assembly.

NOTE THAT PIPING MIGHT REQUIRE ELEVATION IN ORDER TO FIT THE RIB BENEATH - SEE PAGE 22 “RECOMMENDED ASSEMBLY AID” FOR COMPLETE DETAILS.

STEP 2
Next, bring end “A” up and over piping and union assembly. Insert end “A” down through end “B” opening. Pull “A” back through to original side as shown.

At this point keep END “B” stationary
**STEP 3**
Continue to bring end “A” back around to form a second loop. Rib profile should still evenly straddle union assembly as shown.

**STEP 4**
Draw end “A” even with “B” end as shown. Ensure that the Rib profile fits snugly around union assembly (or other applicable connection). This Rib is now ready for Spine installation. See Page 10-13 for correct spine installation.

**NOTES:**
a) Rib profiles must always STRADDLE each side of wing union connection. This configuration provides the most purchase to contain flow line components on either side if the union fails.
b) SPM® FSR Ribs can **NEVER** be substituted for SPM® FSR Spines.

c) No SPM® FSR Ribs are required, or should be used, on anchor lines (Anchor lines are the separate SPM® FSR lines that secure the entire SPM® FSR system to separate anchor points).

d) **SPM® FSR Ribs should be installed as tightly as possible.** Excessive play in the overall SPM® FSR System could allow components to release during line failure.

e) In the limited instance where a single SPM® FSR Rib is not long enough to fit around a large component, SPM® FSR Ribs can be “linked” if necessary, but never tied together. For complete information on linking, see linking instructions on pages 23-25 of this Installation Guide.
RECOMMENDED ASSEMBLY AID

It is typically necessary to raise the flow line piping in order to insert Ribs between union connections and the ground. Never attempt to lift piping manually. The suggested method is to use a “pipe jack.” A secondary method is to use a lever and fulcrum. Place lever under flow line as shown and temporarily lift piping to a minimal height using the following guidelines for reference:

a) Do not lift piping more than 6-8 inches. More than this increases the potential of loosening the union seal connection.

b) Never extend any part of your body underneath the piping while it is elevated.

c) Sometimes an opposing force is required from the side opposite the lever. A second lever may be used.

d) Make sure that piping is still in straight line after lowering back to ground. If piping or components are askew, there is potential of leakage through union assemblies.

e) Do not lift piping while flow line is under pressure.
INSTALLING SPM® FSR COMPONENTS - CORRECT RIB CONFIGURATION
(Shown with SPM® FSR Spine installed)

PRIMARY Method
This is the recommended method of installing SPM® FSR Ribs. ROTATE “A” and “B” ends 270° from flat before installing SPM® FSR Spine.
• This takes up extra slack
• Makes connection more secure

Rotate 270°
(Common on 2” Pipe)
SECONDARY Method
Use this method only when there is not enough slack in the RIB material to allow for an additional twist. ROTATE “A” and “B” ends only 90° - 180° from flat before installing SPM® FSR Spine. SPM® FSR Ribs should be installed as tight as possible. Excessive play in the overall system could allow components to release during failure.

SPM® FSR Rib

SPM® FSR Spine

Rotate 90°-180°
(Common on 3” & 4” Pipe)
INSTALLING SPM® FSR COMPONENTS
- REQUIRED RIB LOCATIONS

UNION CONNECTIONS
SPM® FSR Ribs should be installed on EVERY union connection on the flow line (one Rib per union). The Rib envelope must always straddle both sides of the union in order to help contain each end of the adjoining pipes/components.

FLOW LINE COMPONENTS
Virtually all flow line components utilize two wing union connections – usually male x female. Therefore, most flow line components (check valves, plug valves, etc.) require SPM® FSR Ribs installed at each end as shown.
LONG PIPING ASSEMBLIES
Most piping assemblies can be treated like other flow line components - with one SPM® FSR Rib installed on each union connection at each end. However, on piping assemblies 10 feet or longer, Weir Oil & Gas requires that a third SPM® FSR Rib also be installed midway between the two union connections as shown. This center Rib will not have the union connection to help prevent it from sliding, however, field testing has shown that this Rib will help provide extra support should a failure occur.

SWIVEL ASSEMBLIES
Swivel assemblies should have SPM® FSR Ribs installed at each of the following locations:
1. One at each union connection
2. One additional Rib for each additional articulating joint (excluding the joints adjacent to each union connection).

This will result in the following arrangement:
1. Style 50 Three ribs
2. Style 10 Three ribs
3. Style 100 Four ribs
NOTES:
a) There must be one SPM® FSR Rib installed at each union connection. The Rib envelope should always straddle both sides of the union. This is critical in order to help restrain each end of the flow line components.

b) It is recommended that all Ribs are installed on the flow line prior to installing the Spine-main line.

c) Swivel assemblies should have a minimum of 3 SPM® FSR Ribs installed at “unsecured” swivel joint connections.

d) Each SPM® FSR Rib should be installed with minimum slack to ensure that the entire SPM® FSR System installation is as rigid as possible.

e) FSR should be installed in unison with iron rig up to speed installations.
INSTALLING SPM® FSR COMPONENTS – SPINE LINKING
USE THIS PROCEDURE TO LINK SPINE RESTRAINTS TOGETHER TO CREATE ONE MAIN LINE (OR ANCHOR LINES)

STEP 1
Lay out SPM® FSR Spines end to end as shown. For illustration purposes only, we will consider ends “A” thru “D” for this procedure.

STEP 2
While keeping the “B” end stationary, draw “C” end thru as shown.
**STEP 3**
Continue to pull “C” end thru “B” end. Insert “C” end back thru the “C-D” SPM® FSR Spine as shown. As “C” is pulled further, unrestrained “D” end will move towards “B” end.

**STEP 4**
Pull the remainder of “C” end thru until “D” end draws close to “B” end as shown. While holding “B” end stationary, (using either a second person or placing a weight on the “A/B” SPM® FSR) pull “C” end the remainder of the way through.
STEP 5
With “C” end pulled taut, notice how “D” and “C” ends have switched places. Keeping “A/B” SPM® FSR stationary, keep pulling “C” end until the “B/D” connection can no longer be tightened. SPM® FSR link should look like detail shown.

NOTES:
a) LINKING is described in the above procedure. NEVER tie knots in SPM® FSR components. Use only the linking method to attach restraint ends to each other.

b) Every Spine-to-Spine link must be tight. This is critical in establishing an overall tight SPM® FSR.

c) This linking procedure generally applies only to SPM® FSR Spines. However, SPM® FSR Ribs can be linked in the same manner if a single Rib is too short to encircle a larger component.

d) SPM® FSR Spines are rated at over twice the strength of SPM® FSR Ribs. Spines and Ribs should NEVER be linked together.

e) As an extension of (d) above, SPM® FSR Ribs may NEVER be substituted for SPM® FSR Spines.

f) Linked Spines should run parallel down the main line and not twist or be wrapped around the flow line.

g) Spines can also be linked together using approved FSR shackles.
ANCHOR CROSSOVER ASSEMBLY

- DO NOT use “C” type shackles in Anchor Crossover assemblies

- Use “C” type of shackle only to link SPM® FSR spines or tie off at anchor point (See page 30)

- Only “bolt” type shackles should be used

NOTE: There are two types of approved shackles used on a typical SPM® FSR installation. Never substitute the incorrect type of shackle for the non-specified application. Individual shackles or shackles on anchor crossovers are used to tie spine to the shackle and not used to go through the eye or loop of the shackle. See SHACKLE DETAIL ABOVE for complete details.
INSTALLING SPM® FSR COMPONENTS – ANCHOR CROSSOVER ASSEMBLY (PRIMARY METHOD)

Generally, two Anchor Crossover assemblies are required for each swivel group assembly (two or more swivels in line), with one crossover assembly installed on each end.

Anchor Crossovers are installed in this configuration because swivels and swivel assemblies are designed to provide flexibility in a flow line. While this is necessary for simplifying installations, this flexibility allows forces to build up in the event of a flow line failure. By “linking” SPM® FSR Spines to anchor crossover assemblies, the slack in the system can be reduced.

SPM® FSR main lines must always be continuous from anchor point to anchor point (for example, from frac trailer to wellhead). Any time that there is a break in the main line, such as where the main line is shackled to the anchor crossover, a second SPM® FSR Spine main line must continue from that point and make up the continuous main line.

NOTE: There are two types of approved shackles used on a typical SPM® FSR. Never substitute the incorrect type of shackle for the non-specified application. Individual shackles or shackles on anchor crossovers are used to tie the spine to the shackle and not used to go through the eye or loop of the shackle. See SHACKLE DETAIL on page 26 for complete details.
INSTALLING SPM® FSR COMPONENTS – NON-ANCHOR CROSSOVER ASSEMBLY (ALTERNATIVE METHOD)

The following method provides an alternate method to install the SPM® FSR system without Anchor Crossovers at the ends of swivel groups (2 or more in series) and at anchor line end points by using additional linked spines in place of the Anchor Crossovers. This alternate method was developed as a result of feedback from the field where some operators have mandated that flow lines can not contain flow control components of mixed ownership. This will occur, for example, where SPM®’s FSR rental services require rig in of SPM® owned anchor crossovers within a service company’s flow line.

A. Installation of SPM® FSR System without Anchor Crossover on Swivel Groups

NOTE: Figure 1 shows the double swivel assemblies without any SPM® FSRs installed for clarity purposes.

![Double Swivel Assembly](image)

Figure 1. Double Swivel Assemblies without SPM® FSRs
1. Install SPM® FSRs for swivel assemblies as described earlier in this Instruction Guide, except there are no Anchor Crossover Assemblies in this case. The set up is shown in Figure 2.
   a. The swivel assemblies should have SPM® FSR Ribs installed at all wing union connections, and around unsecured swivel joint connections (any ball race location).
   b. One SPM® FSR spine must link all ribs.

   

   Figure 2. SPM® FSR Installation on Double Swivel Assemblies (without Anchor Crossovers)

2. As shown in Figure 3, install two additional Spines on the double swivel assemblies in place of Anchor Crossovers. Note the main Spine and Ribs described in step 2 are not shown here for clarity purposes.
   a. Loop one of the spines around the straight pipe in the area that is located immediate after the swivel assemblies.
   b. Loop another spine around the straight pipe in the area that is located immediately after the other end of the swivel assemblies.
   c. Connect these two spines with an Anchor type (or “C-type”) shackle.
3. Figure 4 shows the complete, final assembly. The main Spine and Ribs are installed with two additional Spines to replace the Anchor Crossovers. The two additional Spines are connected using a “C-type” shackle.
B. Install SPM® FSR Anchor Lines on the Main Flow Line to the Well Head

1. Figure 5 demonstrates the Main Flow Line and the set up of two SPM® FSR Anchor Lines. The directions towards the well head and towards the frac truck are illustrated.

![Figure 5. Main Flow Line with SPM® FSR Anchor Lines](image)

2. As shown in Figure 6, follow the three steps to install SPM® FSR Spine 1 as the connection loops.
   a. Step 1 – Begin by positioning SPM® FSR Spine 1 beneath the main flow line as shown. The Spine profile should straddle union assembly.
   b. Step 2 – Bring End “A” up and over piping and union assembly. Insert End “A” down through End “B” opening. Pull “A” back through to original side as shown.
   c. Step 3 – Continue to bring End “A” back around to form a second loop. The Spine profile should still evenly straddle union assembly as shown.
   d. Keep the loop as small as possible. If SPM® FSR Spine 1 is too long make multiple loops around until the Left and Right Connection Loops are close to the straight pipe section.
Step 1

END “A”

Piping

Union Assembly

END “B”

At this point keep END “B” stationary

Step 2

END “B”

END “A”

Step 3

END “A”

END “B”
3. Install the Left and Right SPM® FSR Anchor Lines as shown in Figure 7. Follow the looping procedure referenced in the following section. Loop the SPM® FSR Spine 2 to the Left Connection Loop and pull until the knot is taut. Loop SPM® FSR Spine 3 to the Right Connection Loop and pull until the knot is taut. It is key that all SPM® FSR components are pulled taut throughout the assembly.
SECURING SPM® FSR SYSTEM ENDS
(This includes both SPM® FSR main lines and SPM® FSR anchor lines)

THERE ARE TWO PRIMARY METHODS FOR SECURING THE SPM® FSR MAIN LINES AND SPM® FSR ANCHOR LINES:

LOOPING
Looping the SPM® FSR Spine around the anchor point, then back through itself (Note: tying off to an anchor point is never acceptable).

“C” SHACKLE
Looping the SPM® FSR Spine around the anchor point, then utilizing an anchor shackle to secure the end back to the SPM® FSR Spine.

*CAUTION: Sharp edges should always be avoided in all SPM® FSR installations. When connecting to a rig/trailer frame or undercarriage, make certain that these surfaces are smooth and do not have sharp edges. Never loop or shackle restraints to pressure lines as an anchor point.
**While large rig axles can be an acceptable source to anchor an SPM® FSR line, if the axle is too oily or greasy, it is generally preferable to select an alternate anchor point to save cleaning time later.**

***When securing an SPM® FSR system to an axle, make sure the anchor point is a substantial member. Also, take care to avoid damaging more intricate rig suspension components.***

**IMPORTANT NOTE:** IT IS RECOMMENDED THAT ANY ANCHOR LOCATION SELECTED FOR TERMINATING THE FSR BE CAPABLE OF ENDURING A “ONE TIME” SHOCK LOAD OF 120,000 LB. REDUCED ANCHOR LOAD CAPABILITIES MAY BE ACCEPTABLE, DUE TO VARIATIONS IN PRESSURE RATING AND NOMINAL PIPE DIAMETER. CONTACT WEIR OIL AND GAS FOR ADDITIONAL RECOMMENDATIONS REGARDING ANCHOR LOCATIONS.
FINAL SPM® FSR SYSTEM INSPECTION
(Always done before energizing the flow line)

A) Make sure that the main SPM® FSR line is continuous, meaning that all SPM® FSR main lines and anchor line ends are secured to an appropriate anchor. This is important. If there is a break in the flow line, any discontinuity in the SPM® FSR line could allow flow line components to move violently.

B) Check that all SPM® FSR Rib installations are tight. (NOTE: This process should be monitored carefully during the SPM® FSR installation. Tightening the SPM® FSR Ribs at a later stage is generally more time consuming.)

C) Ensure that the SPM® FSR main line and SPM® FSR anchor lines are as taut as possible.

D) Make certain that there are no sharp edges that could wear down, fray, or otherwise sever any of the SPM® FSR lines. This is especially true at anchor points such as a Truck or Trailer Frame.

E) Bleed-off (or blowback) lines should be secured with the SPM® FSR System in the same manner as the main flow line.

NOTE: It is imperative that all SPM® FSR components are inspected before each installation. Damaged or otherwise unusable SPM® FSR components should be discarded and replaced.
LINKED SPM® FSR MEASUREMENTS

USE THIS PROCEDURE TO DETERMINE APPROXIMATE AMOUNT OF OVERLAP WHEN LINKING SPM® FSR COMPONENTS TOGETHER.

Note that linking the SPM® FSR Spines together results in a slight reduction in the combined length.

SPM® FSR Ribs

Note that linking the SPM® FSR Ribs together results in a slight reduction in the combined length.

NOTE: ALL LENGTHS ARE APPROXIMATE & SHOULD BE USED FOR REFERENCE ONLY
RECOMMENDED SEQUENCE WHEN INSTALLING SPM® FSR COMPONENTS

Different situations require different installation sequences. The possibilities are myriad and each scenario cannot be discussed in this manual. Should you have anything other than a standard installation, it is strongly recommended you contact Weir Oil & Gas Engineering before proceeding. A standard installation sequence is as follows:

FIRST
Install SPM® FSR Anchor Crossover Assemblies within the flow line where applicable. See page 27 for more information. This is critical because they require installation into the flow line. If these are not included, the flow line must be disassembled and these components installed at a later point.

NOTE: Anchor Crossovers may be included at various points in the flow-line to allow disassembly of a smaller section of the SPM® FSR to access the flow iron. This may be necessary in order to replace internal components.

SECOND
Install the SPM® FSR Ribs next. See pages 14-17 of this guide for more information.

TIP - It is most efficient to have one person lay out all the SPM® FSR Ribs at appropriate locations along the flow line prior to installing them.

TIP - It is recommended that one person lift the flow line with the pipe jack (or similar leverage) while another individual installs the Rib at each wing union connection.
THIRD
Install the SPM® FSR main line Spines next. These Spines should be threaded through the Ribs already installed on the flow line. See pages 23-25 of this guide for reference.

**TIP** - It is recommended to start at one end and work toward the other end.

**TIP** - Installers should remember to twist SPM® FSR Ribs prior to installing the SPM® FSR Spine main line through. This helps ensure a tight installation.

FOURTH
Install the SPM® FSR anchor line Spines. See pages 31-33 of this guide for reference.

INSPECTION
In order to ensure the continued safe operation of the SPM® Flow Line Safety Restraint System, Weir Oil & Gas requires annual SPM® FSR inspection. **Inspection of SPM® FSR components must be performed by a Weir Oil & Gas technicians.** Contact your Weir Oil & Gas sales representative at 1-800-342-7458 to schedule the annual inspection.

The primary mode of inspection is a visual inspection according to SPM® Flow Line Safety Restraint Annual Inspection Procedure. Proof Load Testing is also offered by Weir Oil & Gas. This testing requires multiple samples to be destroyed by pull-test. Though not mandatory, this testing offers an additional level of reassurance.

*Identification tags must be punched or marked with the date the inspection was performed.

Reference Documents for Annual SPM® FSR Inspection:

Weir Oil & Gas Engineering Bulletin 1024
This bulletin briefly explains the annual SPM® FSR procedure and details which documentation is required.
LIMITED WARRANTY AND LIMITATIONS ON WARRANTY

1. Warranty
Weir Oil & Gas warrants that the SPM® FSRs will be free from defects in workmanship and material for a period of six months. This is Weir Oil & Gas sole and limited warranty on this product.

2. Disclaimer
ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, ARISING UNDER STATE OR FEDERAL LAW INCLUDING BUT NOT LIMITED TO ALL IMPLIED WARRANTIES FOR FITNESS OR FITNESS FOR A PARTICULAR PURPOSE OR USE, GOOD AND WORKMANLIKE CONSTRUCTION, MERCHANTABILITY OR WARRANTY OF QUALITY ARE EXCLUDED DISCLAIMED AND EXCLUDED TO THE FULL EXTENT PERMITTED BY LAW.

3. Remedy
By purchasing this product, purchaser agrees that its remedy for any breach of warranty is limited to solely repair and replacement of the product. Purchaser agrees that Weir Oil & Gas will not be liable for any special, indirect or consequential damages.

4. Misuse
Any misuse of the SPM® FSRs such as lifting or towing or improper installation shall void any and all warranties. Further, any mishandling of the SPM® FSRs such as not following the maintenance and care instructions contained in this guide, including but not limited to, exposing the SPM® FSRs to excessive heat shall void any and all warranties.