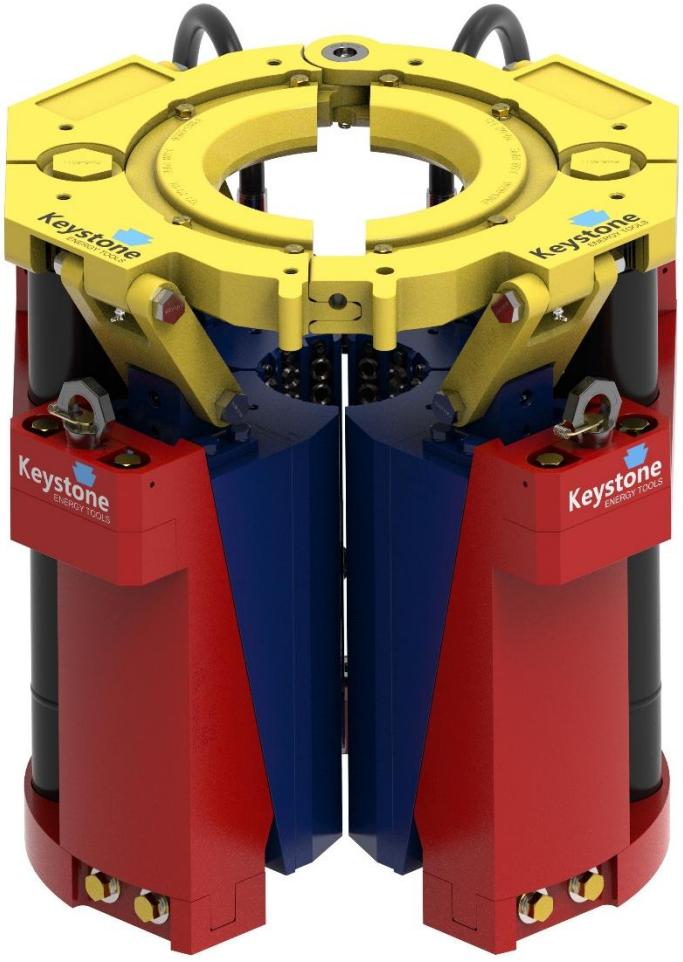
THE KET “FLUSH MOUNTED SPIDER”

OPERATING PROCEDURE MANUAL



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If operating manual is printed or language is translated to any language other than English, then the document is considered uncontrolled.

Flush Mounted Spider

SAFETY INSTRUCTIONS

The most important safety device for this tool is **YOU**. Your good judgment is the best protection against injury.

⚠WARNING

To reduce the risk of injury, everyone using, installing, performing maintenance, changing accessories on, or working near this tool must read and understand these instuctions before performing any such task.

Operating Hazards

⚠**WARNING**: Do not overload the spider. Overloading the recommended rating could cause series injury or death.

⚠**WARNING**: Always ensure that the insert carrier and inserts are correct for the tubular it is to be used on. Failure to use the proper insert carrier or inserts could result in injury or death.

⚠**WARNING**: To prevent injury or spider malfunction, inspect the spider bowls, carriers, slips, inserts, guide plate, retainer plate, retainer screws, latch housing, latch, link bolts, body plates, hinge pin, and safety latch pin regularly for wear. Failure to inspect these parts could cause injury or death.

⚠**WARNING**: Failure to follow the equipment placement/rig-up procedures outlined in this manual may leave the equipment ungrounded and at risk for building a static charge. Assessment for proper grounding must be performed prior to operation to mitigate the spark risks associated with static discharge.

⚠WARNING: keep hands/fingers clear of the spider when operating the spider.

⚠**WARNING**: Do not use undersized pipe. Using undersized pipe could an in adequate pipe coverage. Both of which may result in injury or death.

⚠**WARNING**: All warning labels attached to the equipment must be observed. The warning labels must be present on the tool. Do not remove the labels. If they are missing, replacing is mandatory.

⚠**WARNING**: Only clamp on tubulars when FMS is installed in the rotary or shipping stand.

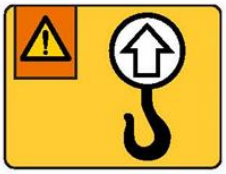
⚠WARNING: The company operating the tool is responsible for issuing work instructions for safe and proper use of the equipment.

⚠WARNING: The operating company is responsible for verifying that any personnel operating, servicing, inspecting, or otherwise involved with the use of the tool must be properly trained correctly.

⚠**WARNING**: hoisting slings will fail if damaged, abused, misused, overused, or improperly maintained. Never stand beneath a suspended tool.

Pay attention: do not place your hands between moving parts.

DO NOT lift from this area.



Be careful when lifting from these areas.

Read Operation manual before use.

DO NOT DISCARD – GIVE TO USER **Keystone** ENERGY TOOLS

Flush Mounted Spider

SAFETY INSTRUCTIONS

The most important safety device for this tool is **YOU**. Your good judgment is the best protection against injury.

Maintenance Hazards

⚠**WARNING**: Use only Keystone Energy Tool components on equipment. Failure to do so may affect the correct functioning of the tool and may cause injury or death.

⚠**WARNING**: KET equipment is made of alloy heat treated steel and should never be welded on.

⚠**WARNING**: Improper welding and/or re-machining of heat treated alloy steel can cause personnel injury, property damage, or death.

⚠**WARNING**: Always depressurize equipment before disconnecting main hydraulic lines or doing anything with hydraulic lines.

⚠**WARNING**: Always wear proper PPE when operating hydraulically powered equipment.

⚠**WARNING**: Improper setup may result in erratic operation and malfunction. Failure to perform a function test following setup increases safety risk to personnel and equipment.

⚠**WARNING**: Always disconnect the power supply and return hoses before proceeding with maintenance – always disconnect supply first and connect it last.

⚠**WARNING**: When repainting equipment, the paint coat being applied should never exceed 2mm thickness. Exceeding this thickness may facilitate static charge buildup and present a possible spark risk associated with static discharge.

⚠**WARNING**: all replacement parts must be OEM equipment in order to maintain equipment integrity.

⚠**WARNING**: Safe rigging practices should be used by trained personnel when handling the equipment. Mishandling of the tool will cause uncontrolled motion and create a hazardous situation for personnel. NEVER lift or move the control consoled while connected to hydraulic power. Console MUST stay in the upright position. When moving, the console must be palletized; moving the console with a forklift will cause instability and potential injury to personnel or damage to equipment.

⚠**WARNING**: never replace protective equipment such as hydraulic switches, circuit breakers, and fuses without first contacting KET.

⚠**WARNING**: Never replace electrical or control hardware without contacting KET.

⚠**WARNING**: Never use any non-OEM replacement parts without the approval of KET. This may void the equipment warranty.

⚠**WARNING**: The hydraulic lines should never be energized when making or breaking hydraulic connections.

⚠**WARNING**: Ensure the hPU is OFF before connecting hydraulic components. Connection under hydraulic power poses severe risk to personnel and damage to hydraulic components.

⚠**WARNING**: Replace hoses as necessary from physical damage and/or at a minimum interval of 60 months of service.

⚠**WARNING**: Quick couplings often fail from mechanical abuse and neglect. More commonly the failures within the coupling body and present as unexplainable hydraulic malfunctions.

1.0 Introduction

This technical manual contains operation and maintenance instructions for the Keystone Flush Mounted Spider, with assembly drawings and complete parts breakdown. It provides a guide for proper field use, disassembling, and repair.

The Hydraulic Flush Mounted Spider (FMS) is a specialized type of rotary equipment that is designed to support tubular running requirements. Using replaceable carriers, the FMS is capable of catching a range of tubulars from 2.3/8" to 14" OD, supporting tubular string weights up to 500 Tons depending on tubular size, and capable of holding back-up torque of up to 80,000 ft-lb when making-up and breaking-out connections. The Flush Mounted Spider assembly is located and held in position over the well head and blowout preventer system by positioning it in the rotary table.

See the product details in the below Table 1, Table 2, and Table 3.

Flush Mounted Spider Specifications	
Load Rating (Max)	500 Tons
Maximum Working Pressure	2500 PSI
Flow Rate	10 GPM (min) / >30 GPM Ideal
Tool Assembly Weight (Without Carrier Assembly)	1988 lb.
Tubular Size Range	2 3/8" – 14"
Time to Extend	3 Seconds
Time to Retract	3 Seconds
Compatible Rotary Table	27 1/2"

Table 1

Load Rating for Carriers	
Casing Size	**Max Rating (Tons)**
5.000-14.000	500 Tons
2.375 - 4.500	350 Tons

Table 2

Maximum Torque Rating at 2,500 PSI Working Pressure	
Casing Size	**Max Torque Rating (ft-lb)**
5.000-14.000	80,000 ft-lb
2.375 - 4.500	40,000 ft-lb
Drill Pipe Size	**Max Torque Rating (ft-lb)**
4.500-5.500	80,000 ft-lb
4.000	70,000 ft-lb

Table 3

1.0 Introduction

The spider assembly is operated using hydraulic pressure. The pressure source forces the piston in the cylinder to extend and retract actuating the leveling plate, slips/insert carriers, and link integrated system to ultimately lift the slips/insert carriers in the open position and set them downward in the holding position/make-up position.

The Flush Mounted Spider incorporates a four-slip gripping mechanism, ensuring a uniform grip with minimum marking to the tubular. All Keystone spiders are made of high alloy, heat treated, steel construction, and are designed to meet or exceed API specifications.

The Keystone FMS insert carriers comes equipped with KET Load Torque Inserts which provide superior gripping performance of tubulars in the axial direction and when holding back-up torque.

KET offers a bolt on position monitoring system as an accessory for added operational safety precautions to avoid accidental dropping of strings. The systems can integrate into various rig systems and has optional control console and driller green and red light position signals.

Below is an illustration (Figure 1) of the 27 ½" Flush Mounted Spider installed into the 37 ½" Rotary Adapter Bushing.

FMS-500-80-1
FMS Assembly

FMS-1100-1
Adapter Bushing Assembly

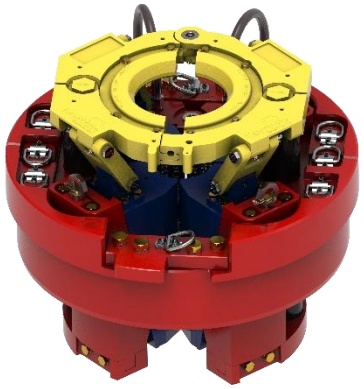


Figure 1

1.0 Introduction

See the below main dimensions of the FMS when its in the fully retracted position and the fully extended position in Figure 2. Holding position will vary based on pipe size and insert size due to extended range.

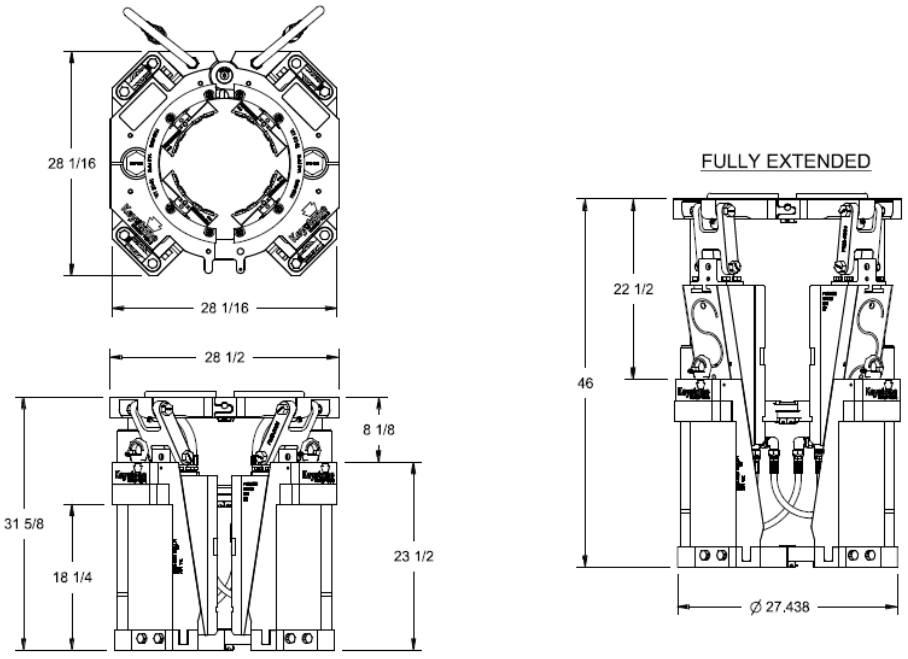


Figure 2

See the below rotary opening dimensions and tolerances in accordance with API Spec 7K in Figure 3.

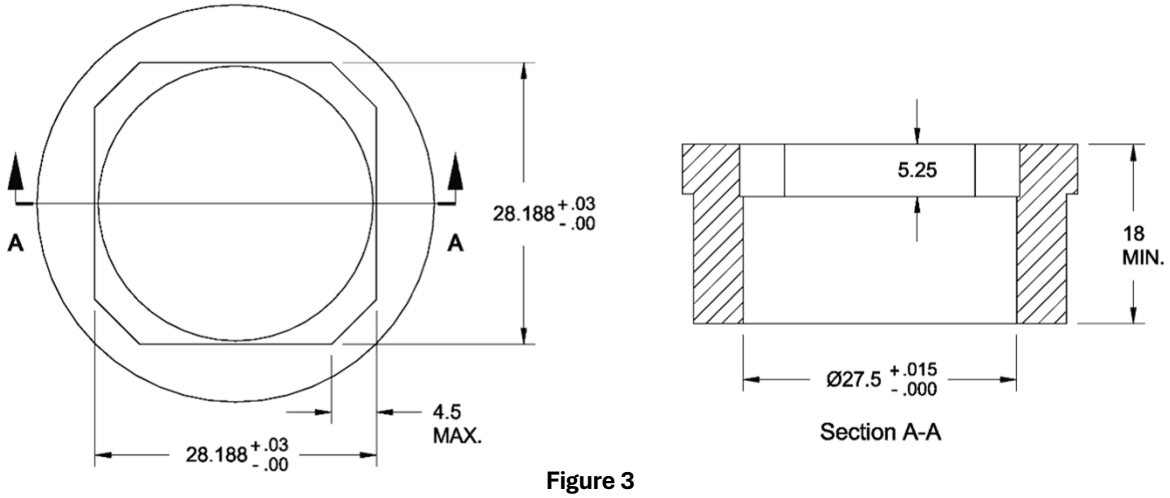


Figure 3

2.0 Installation/Operation

The KET Flush Mounted Spider should only be operated by authorized and trained personnel. The owner/user of the equipment is responsible for ensuring that personnel operating are properly trained. Users are accountable for the safety of all personnel and should be taken into consideration when operating this product. It is also recommended by KET that a hazard assessment, JSA, and/or risk assessment be conducted for the work scope on location.

The operating floor (rig floor) must be kept clutter free with no signs of tripping hazards and/or slipping hazards like drilling mud, grease, and other solvents that create slippery surfaces on the rig floor. There must be adequate lighting in the work area, and all gauges and labels must be clearly visible. All personnel shall be trained on the proper safety, and operation features necessary to facilitate safe and adequate operation of this equipment. Any equipment damaged, injuries, or property damage resulting from improper use of KET equipment will be accountable to the user.

The FMS should never be clamped onto any tubular without being installed in the rotary or an adapter bushing.

If applicable, the FMS Position Monitoring Sensor should be set prior to going out on the job in an adapter bushing or it can be set in the field in an adapter bushing or inside the rotary. For further details on the position monitoring system refer to the operation manual and procedure for the specific position monitoring system. See Section Related and Reference Documents for identification.

KET recommends for all lifting devices and accessories used for lifting and hoisting overhead be in conformance to OSHA, ASME B30.9-2002, or manufacturers guidelines. Lifting devices like slings can fail if they are damaged, misused, or not maintained properly. Improper use of these devices can result in injury or death.

Always ensure that load bearing lifting devices are properly inspected prior to use. The operator should develop inspection frequencies and criteria and documented work instructions for proper safety adherence for shop and field personnel. For more information related to safety guidelines and instructions on load bearing lifting devices refer to the following standards:

- OSHA Regulation for Slings: 1910.184
- ANSI/ASME B30.9: Slings
- ANSI/ASME B30.10: Hooks
- ANSI/ASME B30.25 Rigging Hardware

Load bearing device shall be removed from service if any of the following conditions are observed:

⚠**WARNING**: NEVER STAND OR POSITION BODY PARTs UNDER A SUSPENDED LOAD.

⚠**WARNING**: ALWAYS INSPECT LOAD BEARING LIFTING DEVICES PRIOR TO USE.

⚠**WARNING**: NEVER USE A LOAD BEARING LIFTING DEVICE IF DAMAGED, EVIDENCE OF BEING TAMPERED WITH , SIGNS OF IMPACTS LOADS, BROKEN OR DAMAGED WELDS, EXCESSIVE WEAR, KNICKS, OR GOUGES, OR EXCESIVE PITTING OF COMPONENTS DUE TO RUST OR WHEN CORROSION IS PRESENT.

2.0 Installation/Operation

The FMS can be lifted and moved with the lifting accessory lift ring, see Figure 4 (FMS-1050-1). This lift ring assembly is designed to facilitate the ease of getting the FMS out of the rotary while pipe is present in the rotary and when not. The FMS has 4 swivel hoisting rings located on the body, that are only to be used when lifting the FMS Assembly. In addition, his sling assembly has also been designed for lifting the adapter bushing and it has several D-ring lift point options that can be used for each different type of lifting situation that may be required.

This load bearing device is designed to support the equipment described in this manual. If at any point the device has been altered or modified, the load bearing device will no longer be qualified and rated for its intended purpose.

KET does not qualify or guarantee the ability of the load bearing device when lifting or supporting equipment not described in this manual.

⚠**WARNING**: NEVER MODIFY OR ALTER A LOAD BEARING DEVICE.

⚠**WARNING**: NEVER USE ANY LOAD BEARING LIFTING DEVICE DESCRIBED IN THIS MANUAL TO LIFT EQUIPMENT THAT IS NOT DESCRIBED IN THIS MANUAL.

KET recommends all lifting devices and accessories used for lifting and hoisting overhead be in conformance to OSHA, ASME B30.9-2002, or manufacturers guidelines. Lifting devices like slings can fail if they are damaged, misused, or not properly maintained. Improper use of these devices can result in injury or death.

Always ensure that load bearing lifting devices are properly inspected prior to use. The operator should develop inspection frequencies and criteria and documented work instructions for proper safety adherence for shop and field personnel. For more information related to safety guidelines and instructions on load bearing lifting devices refer to the following standards:

- OSHA Regulation for Slings: 1910.184
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- ANSI/ASME B30.10: Hooks
- ANSI/ASME B30.25 Rigging Hardware

Load bearing device shall be removed from service if any of the following conditions are observed:

- Excessive pitting caused from rust or corrosion
- Presence of cracks
- Evidence of alterations or tampering
- Evidence or signs of impact on components
- Broken or damaged welds
- Excessive wear, nicks, or gouges
- Presence of frayed wire

⚠**WARNING**: IF AT ANY POINT A LOAD BEARING DEVICE HAS BEEN DAMAGED OR OVERLOADED, IT MUST BE IMMEDIATELY REMOVED FROM SERIVCE AND QUARENTINED UNTIL IT HAS BEEN CORRECTLY DISPOSITONED OR RE-CERTIFIED.

FMS-1050-1 Lifting Sling Assembly
Figure 4

2.0 Installation/Operation

Any component part of the FMS that is painted yellow, rotates, moves, and/or identified below are identified as a hazardous areas. Contact with those areas shall be avoided during operations. No contact with hands, feet or any body part. See hazardous areas in Figures 5 & 6.

⚠**WARNING**: FAILURE TO DO SO MAY RESULT IN BODILY INJURY AND/OR DEATH.

Always verify that the hydraulic power is deactivated, and hydraulics lines are de-pressurized before connecting or disconnecting the main hydraulic lines from the FMS (even when disconnecting or connecting quick-connect hydraulic fittings).

⚠**WARNING**: ALWAYS WEAR PROPER PPE WHEN OPERATING HYDRAULICALLY POWERED EQUIPMENT.

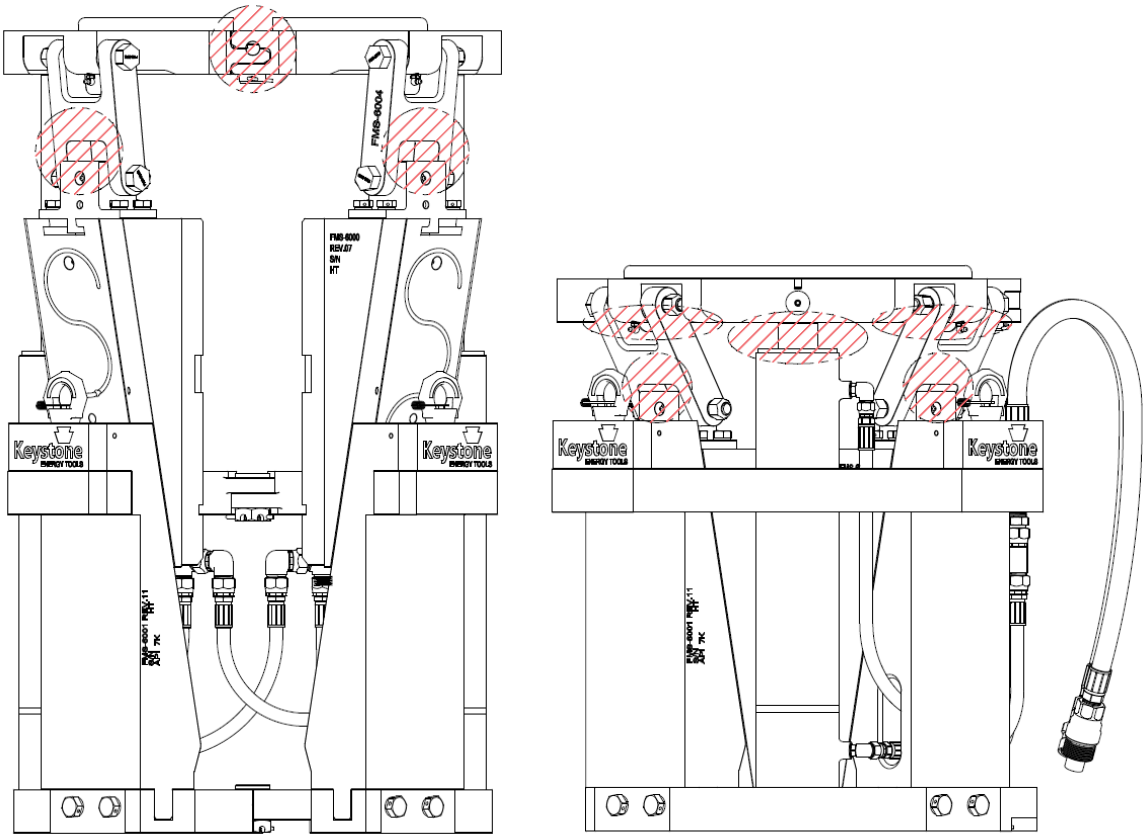


Figure 5

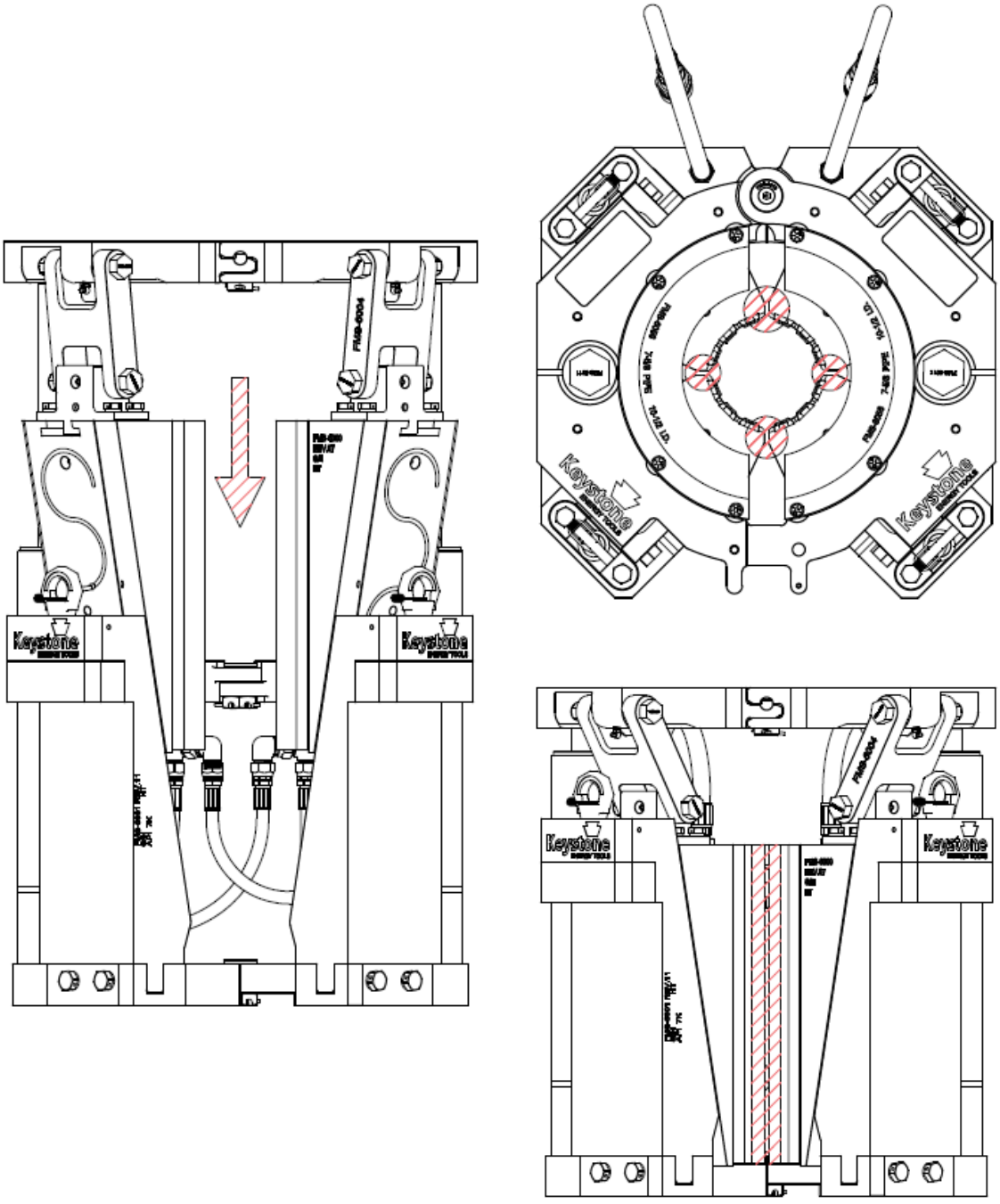


Figure 6

2.0 Installation/Operation

Installation of FMS with a 37 ½" Rotary

When rig operations utilize a 37 ½" rotary, an adapter bushing must be installed into the rotary table to accommodate the 27 ½" FMS. The installation sequence is as follows:

1. Install the adapter bushing into the rotary.
2. Insert the 27 ½" FMS into the adapter bushing.

When utilizing the spit adapter bushing assembly, ensure the FMS is properly aligned within the adapter bushing. The hinge of the FMS must be positioned 90 degrees from the split line of the adapter bushing. Do not align the FMS hinge with the adapter bushing's split line under any circumstances.

⚠**WARNING**: NEVER LIFT ADAPTER BUSHING WITH FMS INSTALLED.

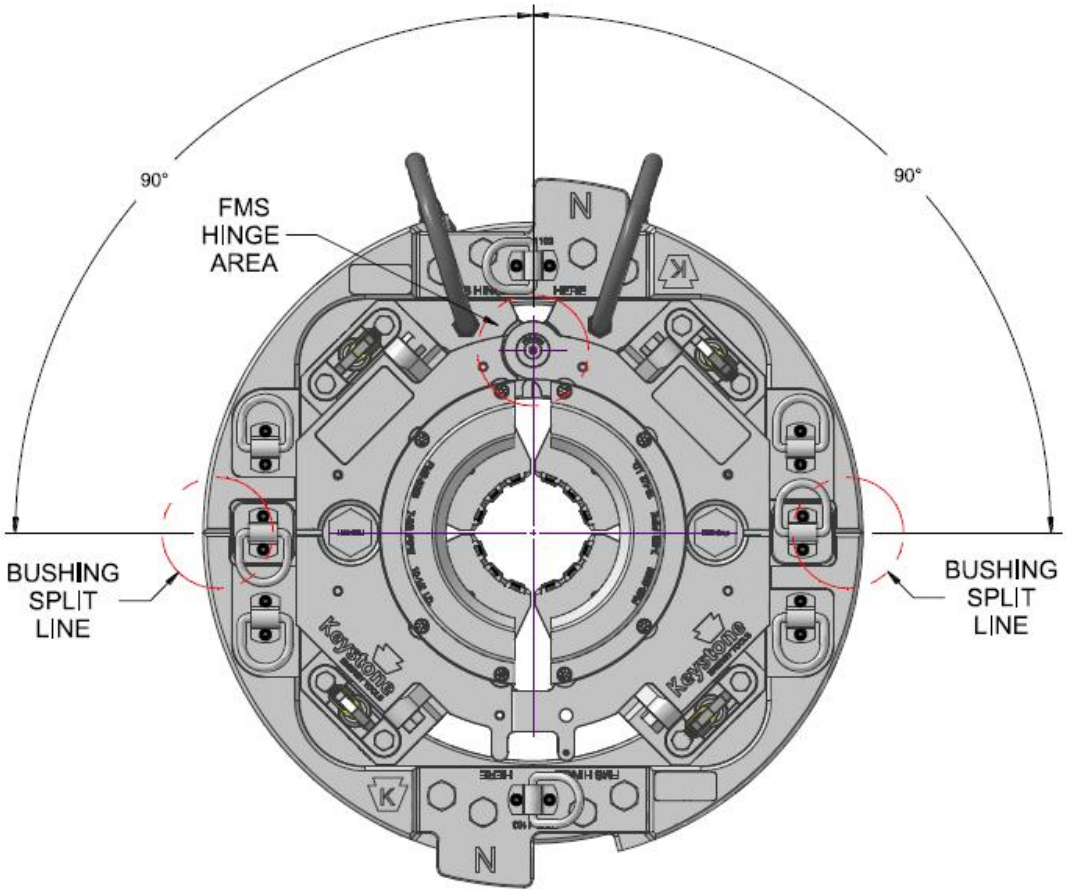


Figure 7

2.0 Installation/Operation

The FMS should never be latched on any tubular without being installed into the rotary table. The rotary table on the rig floor must be positively locked while the FMS in installed. The following steps outline the operation requirements of the FMS:

1. Always confirm the connection torque data, weight, grade, and tubular OD to ensure insert carrier and load torque insert size are correct.
2. Lift the FMS, Adapter Bushing (if applicable), and Control Console using a suitably rated rig hoist to position where required. It is recommended to use a tagline to keep the tool from becoming uncontrollable when hoisting the equipment into position on the rig.
3. Slips should be lifted out of the fully retracted position and safety latched pinned prior to inserting in the rotary.
4. Connect the hydraulic hoses from the HPU to the control console, run the hoses from the control console to the FMS, and if using a tong connect the hoses to the power tong. If the control console is not used to supply the power tong, then a hose is required to close the loop on the control console by running a hose from the tong input to the tong output.
5. Start the HPU, open the pressure valve, and now hydraulic pressure can be applied to the system.
6. Function test the FMS and Power Tong (if applicable)
    - Unset FMS “SLIP UP” (check for RED blinking light if equipped with Position Monitoring)
    - Set FMS “SLIP DOWN” (check for GREEN blinking light if equipped with Position Monitoring / won’t blink green if not on tubular)
    - Float FMS (verify the pressure is bled off to 0 on both valves)
    - Confirm all pressures are correct (2,500 PSI “Slip Down” & 750 PSI “Slip Up”)
    - Confirm slip cycle time is 3 seconds up and 3 seconds down

Running Tubular In

The slips/insert carriers must be fully extended in the up position before running tubulars through the FMS.

1. Always stop the tubular from moving before actuating the FMS slips and gripping the tubular. Never actuate the slips on moving tubular.
2. Once the FMS slips are set on the tubular at the desired stump height, slowly release the weight of the string by lowering the rig hoisting equipment.
3. Once the weight is completely held by the FMS, the rigs hoisting equipment can be removed.
4. Once the connections are made-up and the rig's hoisting equipment is on the pipe, the FMS should be put into float mode. Once in float mode, the rig’s hoisting equipment can begin lifting the string to remove the load from the FMS.
5. Now that the load of the string is off the FMS and being held by the rig’s hoisting equipment, release the FMS by raising the slips into the up position.
6. Normal running operations can be continued by repeating the above steps 6-11.

⚠**WARNING:** VERIFY THE FMS IS FULLY EXTENDED IN THE UP POSITION BEFORE RUNNING ANY ACCESSORIES THROUGH THE FMS INTO THE WELL BORE.

2.0 Installation/Operation

The FMS is designed to hold back-up torque in place of a back-up tong and can be used from the first joint through the entire string to carry out normal torquing capability's up to 80,000 ft-lb. depending on pipe size. The rotary table position needs to be locked for the FMS to hold back-up torque on your tubular.

Making-up Connections

1. Using the rig's hoisting equipment latch onto the tubular.
2. Hoist or stand the joint off into the derrick and center the tubular with the FMS.
3. Lower the tubular through the FMS until the desired stump height is achieved.
4. Set the slips into the "Slip Down" position.
5. The next joint can now be brought in and stabbed into the existing joint.
6. Now torque can be applied to make-up the connection with the rig equipment.
7. Once the connection is confirmed to be made-up, to the required torque, the FMS needs to be put into float mode.
8. Once the rig's hoisting equipment is supporting the weight of the string, you can lift up on the sting and raise the slips into the "Slips Up" position.
9. Lower the tubular to the desired stump height and confirm with the driller to set the slips once the tubular has stopped traveling.
10. Release the string with the rig's hoisting equipment and repeat steps 1-8.

Tripping Pipe & Breaking-Out Connections

1. With the string being supported by the spider in the rotary, position the hoisting equipment in place to take the weight of the string.
2. Place the FMS into float mode and begin to lift up the string with the hoisting equipment to take the weight of the string from the FMS.
3. Once the Hoisting equipment has the full weight of the string, actuate the FMS to the slips up position.
4. With the slips in the up position, lift the string up until you are at the necessary height to break out the connection of pipe.
5. When the string is no longer moving and at proper height, the FMS can be actuated to the slips down position.
6. The FMS can now be used to hold backup on the string as the connection is broken out.
7. After the connection is broken out and the pipe is laid out or racked back, you can repeat the above steps throughout the duration of the string.

2.0 Installation/Operation

Leveling Plate Latch Pin

When installing/removing the FMS in/out of the rotary with pipe present in the hole, the FMS installation pin must be removed and stowed in the park position, as shown below in figure 10. Once the FMS is in the rotary, in order to prevent damage to the tool, the installation pin must be reinstalled into its working position prior to operating the FMS and engaging the slips on tubulars as shown in figure 8 & 9.

⚠WARNING: VERIFY THE LEVELING PLATE INSTALLATION PIN IS IN THE CORRECT POSITON BEFORE RUNNING TUBULAR WITH THE FMS INTO THE WELL BORE. FAILURE TO FOLLOW INSTRUCTIONS CAN RESULT IN EXCESSIVE WEAR AND/OR EQUIPMENT DAMAGE.

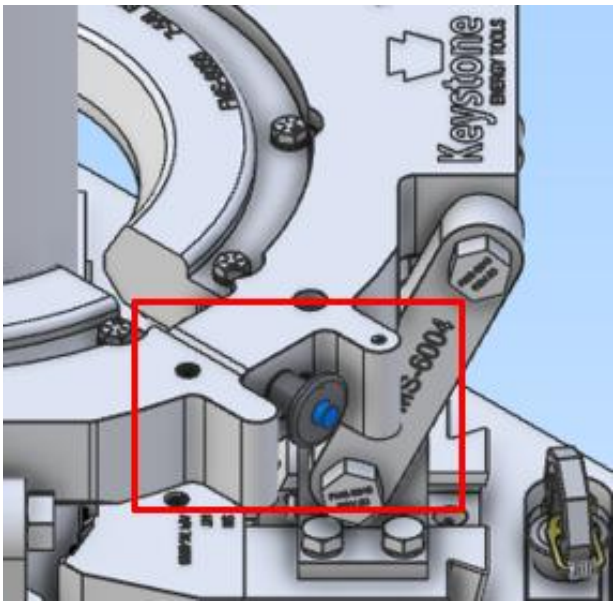


Figure 8

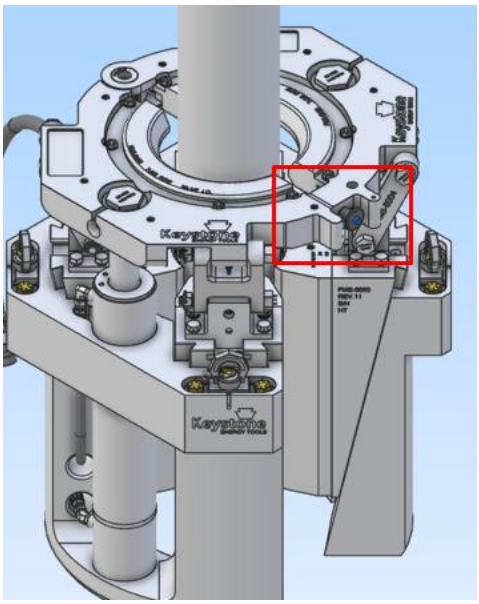


Figure 9

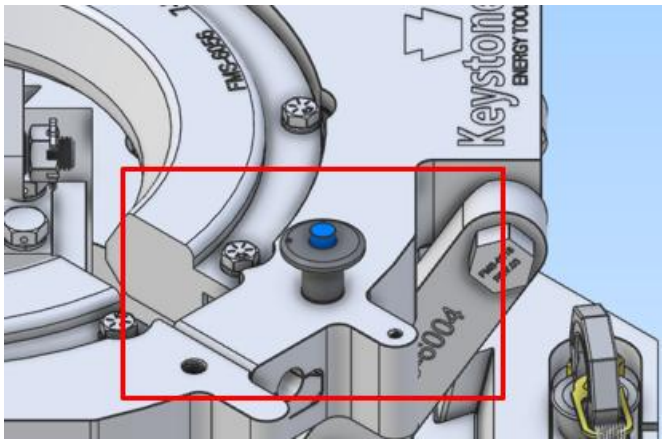


Figure 10

2.0 Installation/Operation

Control Panel

It is recommended to operate the FMS utilizing a KET provided control console. If not, the control panel used to operate the FMS should be equipped with a safety mechanism feature that will prevent accidental dropping of the string. One example is a 2 hand operations to be able to lift the slips up. The control panel also needs valves incorporated with a float position to allow the pressure on both sides of the cylinders to bleed to the holding tank.

If the control panel does not have a float mode option, there is a possibility that the FMS can be lifted out of the rotary when the traveling block lifts up on the tubular when the FMS is clamped in the holding position potentially causing damaged to the FMS and its hydraulic components.

⚠**WARNING:** WHEN USING A CONTROL CONSOLE OR SYSTEM WITHOUT A FLOAT MODE, THE HYDRAULIC CYLINDERS COULD POTENTIALLY BE DAMAGED IF FMS IS LIFITNG OUT OF THE ROTARY BY THE ELEVATOR, BLOCK, OR CRT.

The control panel is required to have a detent lever in the retracted position and fully extended position to maintain the adjusted pressure of 2,500 PSI is maintained on the FMS assembly. The “Slip Up” operating pressure in the control console must be set at 750 PSI. Review the control console operation manual for further details and information. Reference the Related and Reference Document section of this manual.

⚠**WARNING:** THE “SLIP UP” OPERATING PRESSURE IN THE CONTROL CONSOLE MUST BE SET AT 750 PSI TO PREVENT THE SLIPS FROM BEING ABLE TO LIFT THE SLIPS UP WHEN HOLDING THE WEIGHT OF THE STRING.

⚠**WARNING**: **NEVER** LIFT OR MOVE THE CONTROL CONSOLE WHILE CONNECTED TO HYDRAULIC POWER. THE CONSOLE **MUST** STAY IN THE UPRIGHT POSITION AT ALL TIMES.

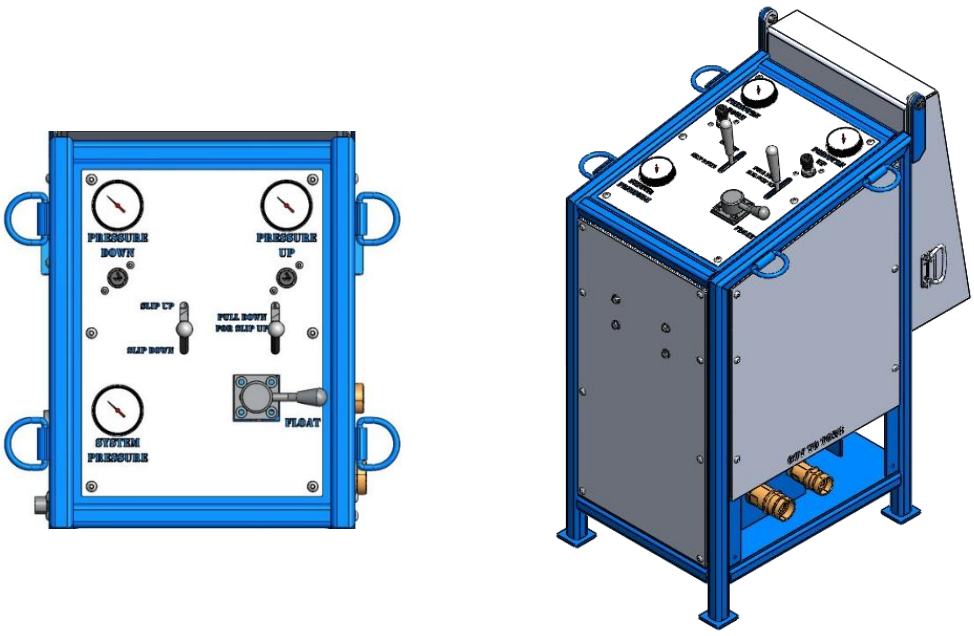


Figure 11

3.0 Disassembly/Assembly

Insert Carrier Removal and Assembly Instructions

To properly disassemble the FMS ,the slips need to be extended into the fully up position and hinged open.

Step 1: Start with removing the guide plates first. The guide plates are held in the leveling plate with retainer bolts. Remove the (4) guide plate retainers bolts and lock washers on each half to remove the guide plates. See figure 12.

Fig. 12

NOTE – it may not always be necessary to remove the guide plate when changing out insert carriers.

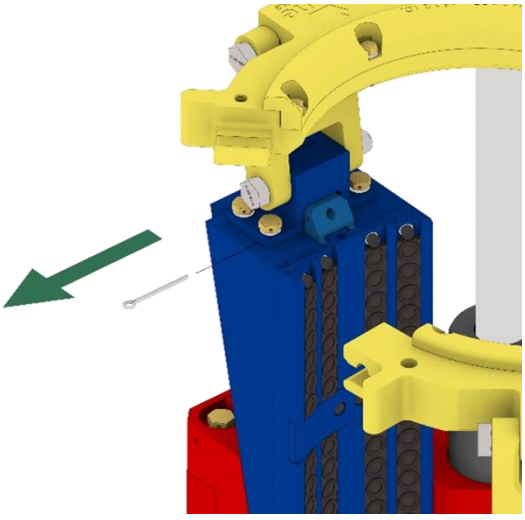


Fig. 13

Step 2: Remove the cotter pin from the latch. The cotter pin is used as secondary retention preventing the latch from functioning and accidently dropping of an insert carrier. See figure 13.

Step 3: Using the Latch Mechanism Release "T-Handle" Tool, insert it into the back of the latch housing to extract the latch back into the housing. See Figure 14.

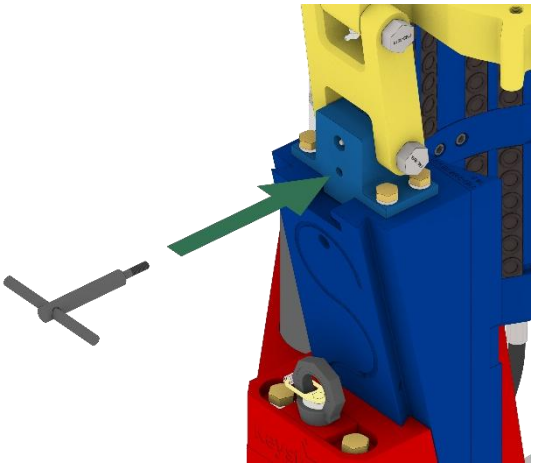


Fig. 14

3.0 Disassembly/Assembly

Insert Carrier Removal and Assembly Instructions

Step 4: By turning the T-handle tool clockwise the latch will slide back into the housing far enough for the insert carrier to not be held in by the latch. See figure 15 & 16.

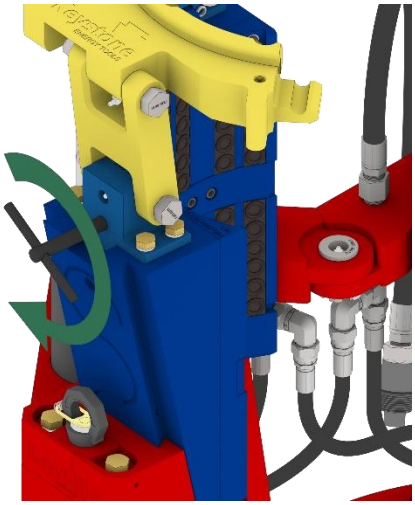


Fig. 15

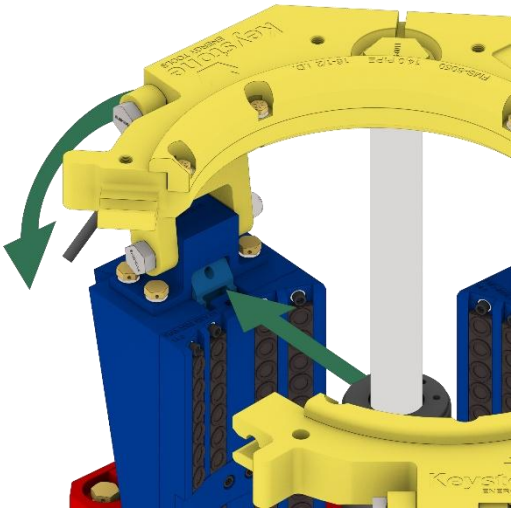


Fig. 16

Step 5: Use an eye bolt by screwing it into the tapped hole on top of the carrier as a lifting point when using an overhead crane for removal. The Insert carrier can be removed from the slip by lifting up and out on it. Majority of the die carriers have two tapped holes for lifting points on top. For ease of assembly and disassembly it is recommended to use the tapped hole closes to the latch. See figure 17.

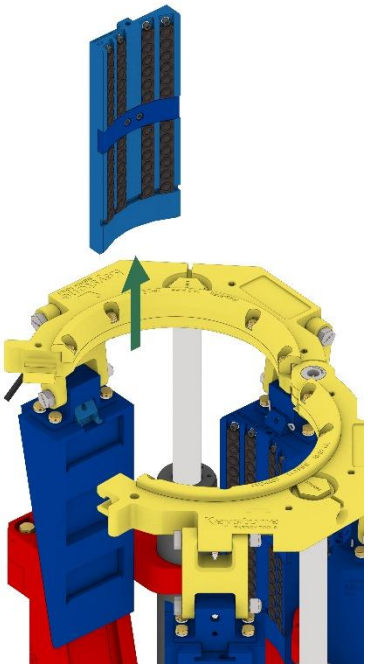


Fig. 17

3.0 Disassembly & Assembly

Lifting Sling Accessory For Insert Carrier Removal

To facilitate the ease of removing the insert carriers from the FMS assembly, KET offers a specific lifting sling for removal. Part# FMS-1060, see Figure 18. The sling is one legged with a hook on the end that is designed to lift the insert carrier with eye bolts screwed into the top of the carrier.

FMS-1060
Insert Carrier Lifting Sling
Figure 18

3.0 Disassembly & Assembly

KET Load Torque Insert Removal and Assembly Instructions

⚠**WARNING:** ALWAYS WEAR PROPER PPE WHEN REMOVING OR REPLACING INSERTS TO PROTECT AGAINST BODILY INJURY.

Step 1: Once the carriers have been removed from the assembly, the insert retainer bolts at the top of each insert slot need to be remove.

See figure 19.

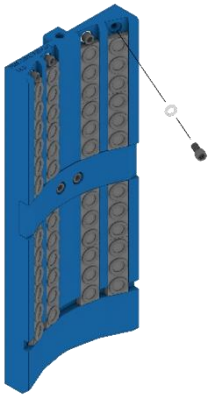


Fig. 19

Step 2: Remove the first 2 rows of inserts from the insert carrier slots.

See figure 20.

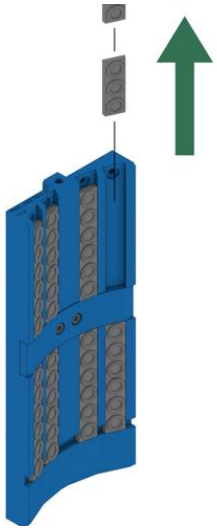


Fig. 20

Step 3: Next remove the load carrier plate bolts and load carrier plate from the insert carrier.

See figure 21.

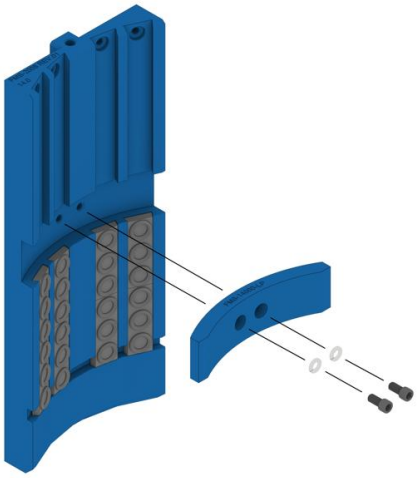


Fig. 21

Step 4: Then the lower 2 rows of inserts can be removed from the carriers.

See figure 22.

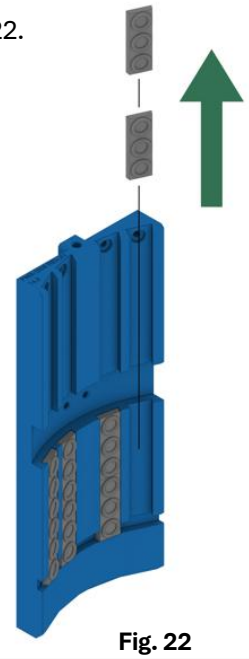


Fig. 22

3.0 Disassembly & Assembly

Leveling Plate Removal and Assembly Instructions

Step 1: First Remove the guide plate retainer bolts and guide plates from the leveling plate. Fig. 23

Step 2: Remove the top link pins from the link and leveling plate. Fig. 24

Step 3: Remove the cylinder cap set screws and cylinder end caps from the leveling plate. Fig. 25

Step 4: Install the lifting eyes in the leveling plate and lift the leveling plate off of the assembly. Fig. 26

*NOTE- Install the cylinder end caps back on the cylinder ends to prevent damaged to the threads during disassembly.

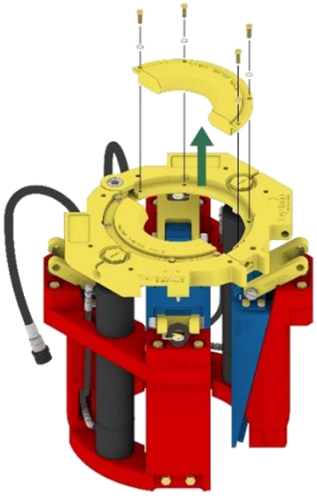


Fig. 23

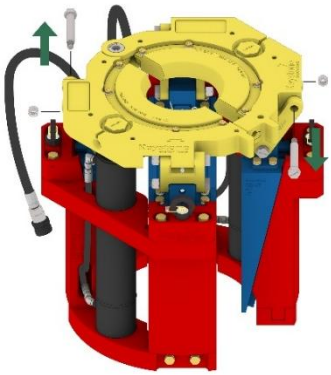


Fig. 24

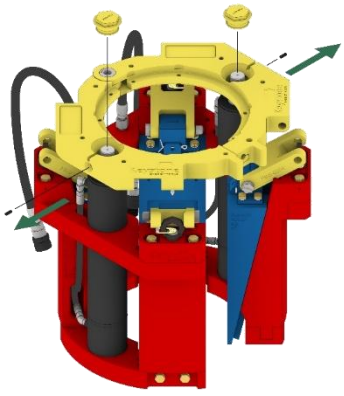


Fig. 25

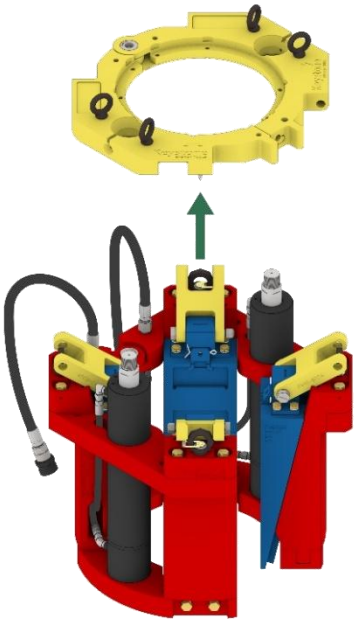


Fig. 26

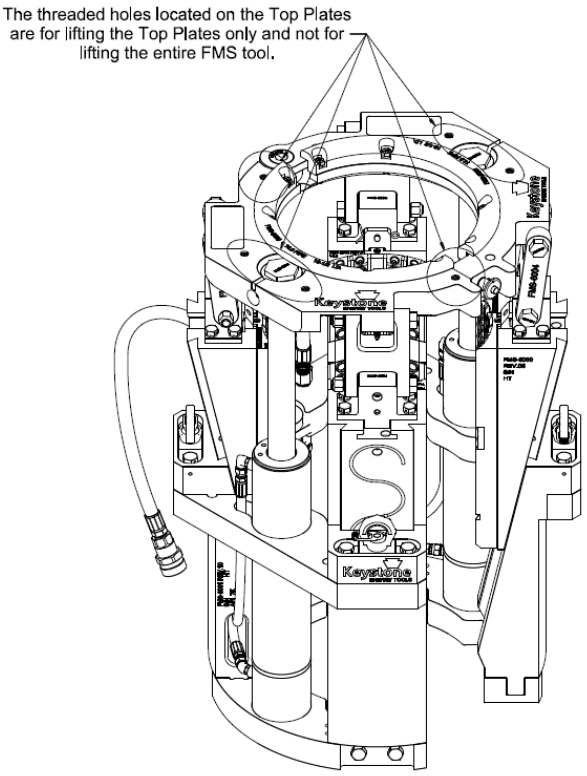


Fig. 27

Slip Assembly & Latch Mechanism Removal

Start by installing the upper link hinge pin back into the link. Then with a strap wrapped around the link pin lift each slip segment out of the assembly until all 4 have been removed.

Remove the lower link pins from the link to remove the links from the latch housing.

To remove the latch housing and mechanism start by removing the latch housing retainer bolts and the latch housing, latch spring, and latch can be removed. The latch can only slide out of the slip from the bowl side.

3.0 Disassembly & Assembly

Cylinder Removal

Step 1: Remove hydraulic hoses and fittings from cylinder.

Step 2: Remove the upper and lower hydraulic fitting from the cylinder housing. See Figure 28.

Step 3: Remove the cylinder retainer bolts from the bottom body plate. See Figure 29.

Step 4: Remove the cylinder by lifting it out of the body plate assembly. See Figure 30.

*NOTE- KET offers an accessory lifting cap to be used for removal/assembly of the cylinder. See accessory lifting procedure in Figure 31.

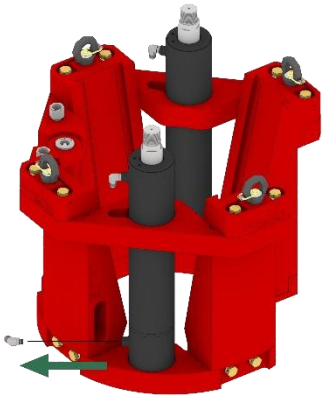


Fig. 28

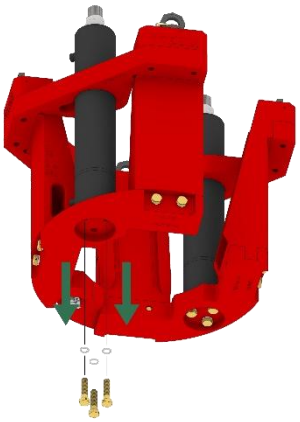


Fig. 29

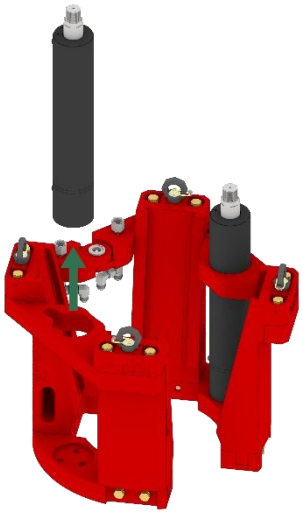


Fig. 30

Body Plate and Bowl

To disassemble the bowl and body plates, first remove the lower body plates retainer bolts and then remove the upper body plate bolts second. Secure the weight of the upper body plate prior to removing bolts. Once the upper bolts are removed, lower the upper body plates until they are sitting on top of the lower plates. Now the bowls can be removed, and the plates can be taken apart by removing the hinge pins from them.

All bolts on the FMS must be Grade 8 or equivalent, lubricated, and torque to the below torque specifications. See Table 4.

Grade 8 – Course Threads Bolt Torque Specifications Per ASTM A307		
Size	**Size**	**Lubricated (ft-lb)**
Retainer Bolts	3/8-16	33
Guide Plate Retainer Bolts	1/2-13	80
Latch Housing Bolts	5/8-11	159
Body Plate Bolts	3/4-10	282
Cylinder Cap	1 3/8-12	1,110

Table 4

3.0 Disassembly & Assembly

Cylinder Removal

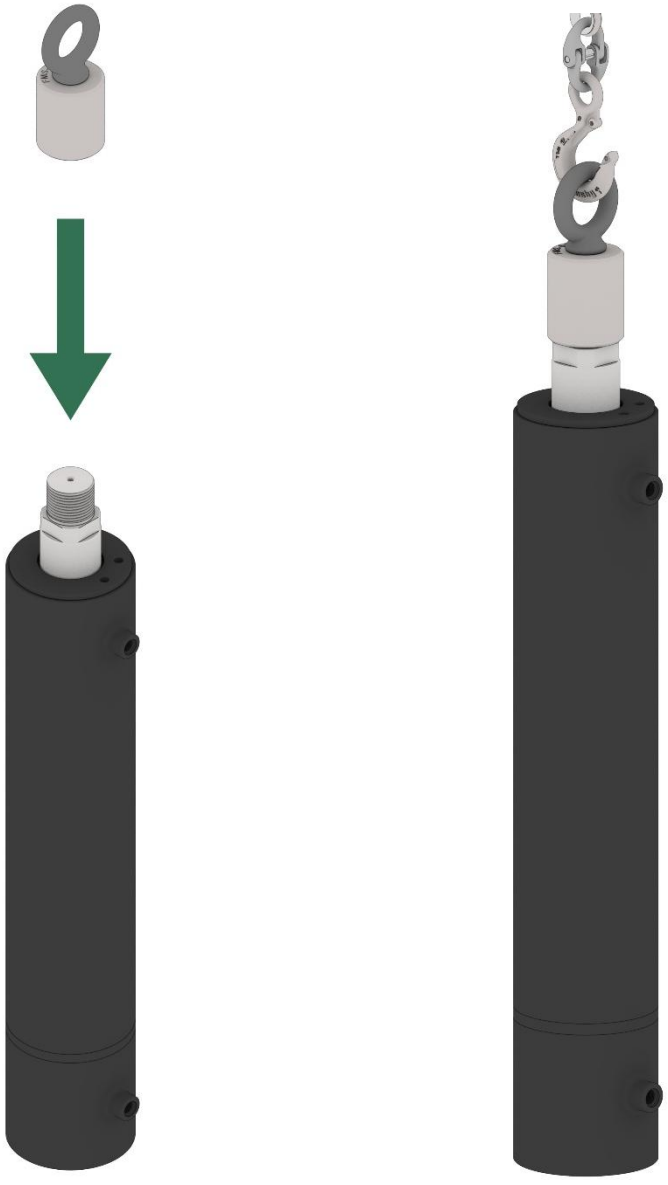


Figure 31

4.0 Carrier & Insert Information

The insert carrier assemblies are manufactured as a matched set of 4. One set will be required to correctly dress the tool. The below table lists the insert carrier size and what insert is required based on the size tubular size being run. The table also identifies the insert quantity required, guide plate diameter, and diameter when the slips are in the fully extended position “Up Position”.

The KET FMS insert carrier travel provides a 1” reduction in pipe size when using a basic insert. The tool can be reduced down another ½” when using a reducing die in the same insert carrier size. See table 5.

*NOTE- The KET FMS uses only 1 insert that is used to support the axial string weight and back-up torque.

FMS INSERT USAGE INFOMRATION			INSERT CARRIER INFORMATION		
Pipe Size	**Keystone Insert Part #**	**Insert QTY Required**	**Die Carrier Size**	**Diameter of Guide Plate**	**Diameter Full Open**
2-3/8" to 3-1/2"	FMS-INS-2375	16	3-1/2"	6.130"	7 5/8”
4" to 4-1/2"	FMS-INS-4050	32	5-1/2“ - DP	8.50"	8 15/16”
4-1/2" to 5-1/2"	FMS-INS-4050	32			9 7/16”
4" to 4-1/2"	FMS-INS-4050	32	5-1/2"	8.50"	8 15/16”
4-1/2" to 5-1/2"	FMS-INS-5500	32			9 7/16”
4 1/2” to 5”	FMS-INS-4550	32	6”	9.00”	9 7/16”
5” to 6”	FMS-INS-6000	32			9 15/16”
5-1/2" to 6"	FMS-INS-5560	48	7"	9.630"	10 3/8”
6" to 7"	FMS-INS-7000	48			10 7/8”
6-1/8" to 6-5/8"	FMS-INS-6166	48	7-5/8"	10.350"	10 1/2”
6-5/8" to 7-5/8"	FMS-INS-7625	48			11 1/2”
7-1/8" to 7-5/8"	FMS-INS-7176	48	8-5/8"	11.500	12”
7-5/8" to 8-5/8"	FMS-INS-8625	48			12 1/2”
8-1/8" to 8-5/8"	FMS-INS-8186	64	9-5/8"	12.380"	12 7/8”
8-5/8" to 9-5/8"	FMS-INS-9625	64			13 3/8”
10-1/4" to 10-3/4"	FMS-INS-101107	64	11-3/4"	14.500"	14 15/16”
10-3/4" to 11-3/4"	FMS-INS-11750	64			15 7/16”
12-1/2" to 13"	FMS-INS-12513	64	14"	15.250"	16 15/16”
13" to 14"	FMS-INS-14000	64		15.750"	17 1/2”

Table 5

5.0 Hydraulic Information

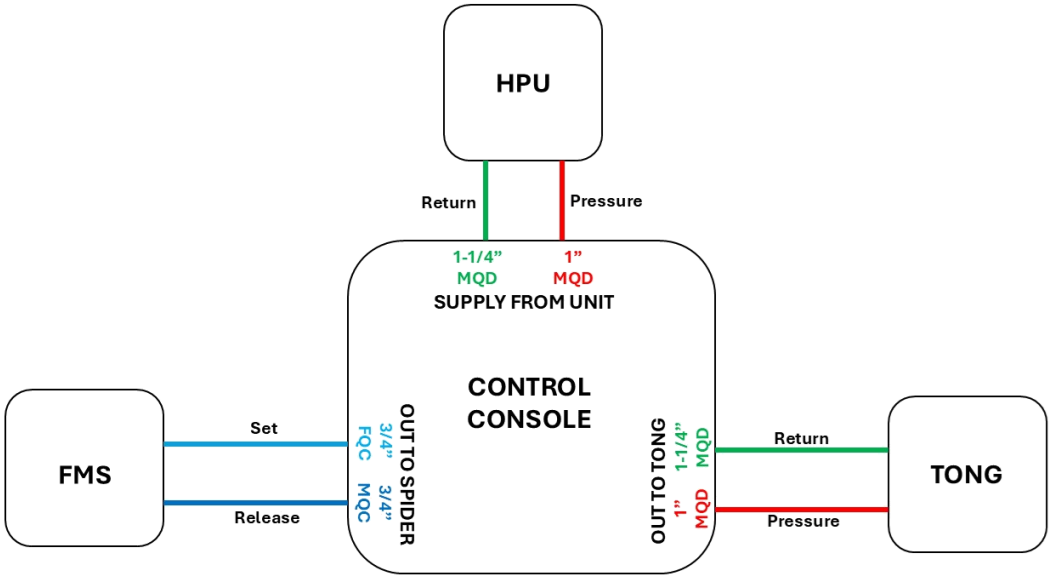
FMS Hydraulic System Information

When operating this equipment, you must use high quality hydraulic fluid containing rust, oxidation inhibitors, and foam suppressants that meet or exceed industry recommend requirements. When operating KET-FMS equipment without using the proper required fluid will greatly increase the chances of premature component wear, premature seal failure causing damages to the equipment.

When selecting the proper hydraulic fluid also consider climate, operating conditions, and equipment load. Each specific grade of hydraulic fluid will have its own specific operating parameters.

KET recommends utilizing hydraulic fluid heaters & coolers to ensure the hydraulic fluid is maintained within the normal operating temperature range specified by the oil manufacture.

⚠ WARNING: Maintaining hydraulic oil temperature within the specified operating range is essential for proper FMS performance. Cold oil in freezing conditions can cause sluggish response and improper operation, while overheated oil can lead to component damage and reduced system life. Operators must continuously monitor oil temperature and allow proper warm-up and cooling as required.



5.0 Hydraulic Information

FMS Hydraulic Hose Plumbing Illustration

Cylinder Extend hoses should be plumbed to the left side of the tool (as shown in red) and equipped with male fitting

Cylinder Retract hoses should be plumbed to the right side of the tool (as shown below in blue) and equipped with female fitting

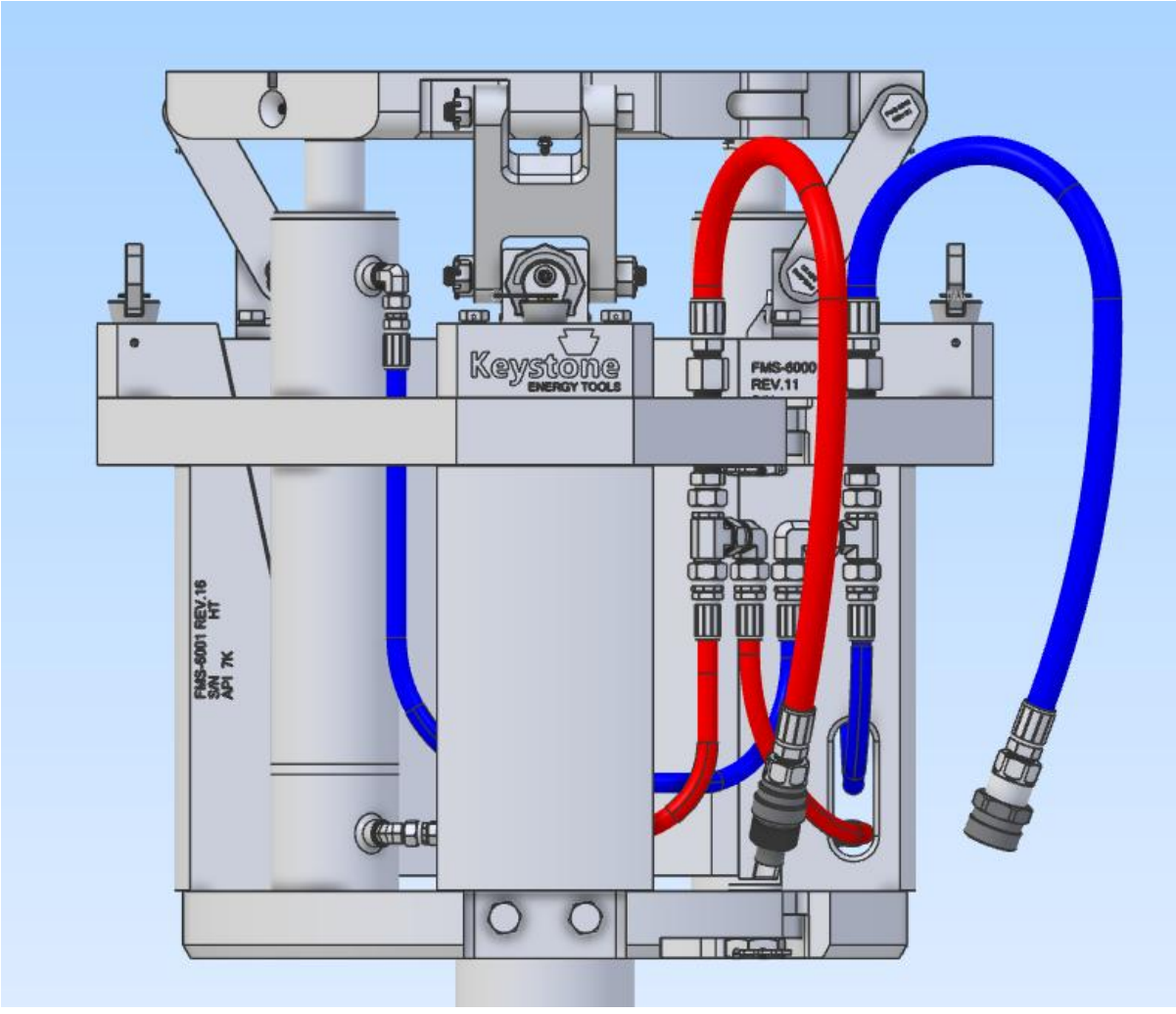
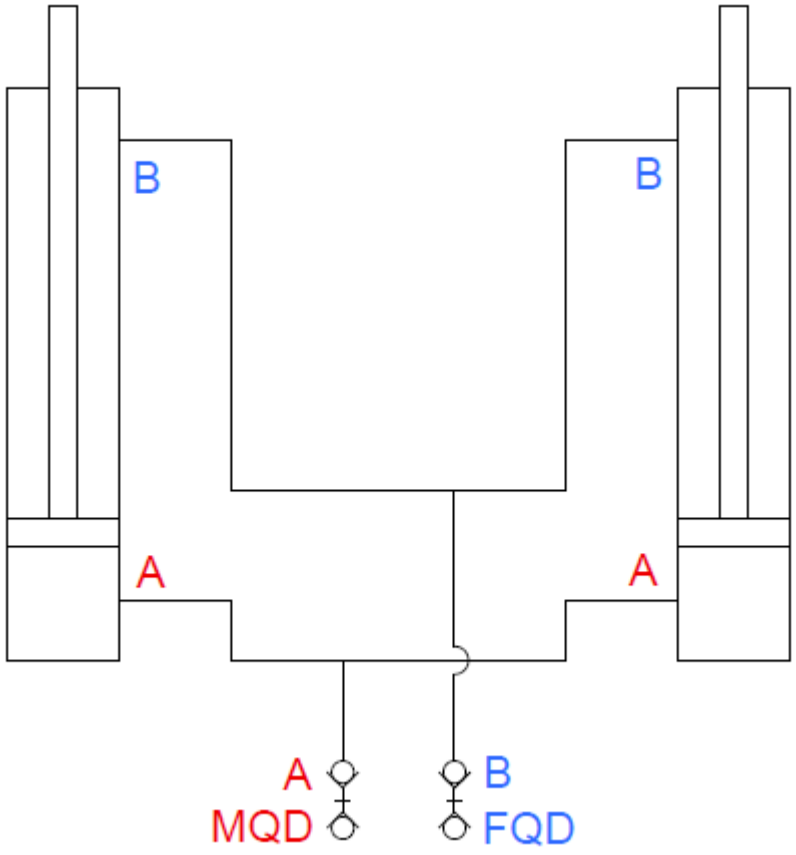


Figure 32

5.0 Hydraulic Information

FMS Hydraulic System Information

See the below hydraulic schematic for the FMS.



5.0 Hydraulic Information

FMS Hydraulic System Information (Control Console Parameters)

Hydraulic Fluid Requirements				
Characteristics			**Metric**	**US**
Maximum Pressure	**Port, A/B continuous with PVS end plate**		300 bar	4351 psi
	Port P, A/B Continuous with PVSI end plate		350 bar	5075 psi
	Port P intermittent		400 bar	5800 psi
	Port A/B intermittent		420 bar	6090 psi
	Port T, static/dynamic		25/40 bar	365/580 psi
Oil Flow Rated	**Port P with PVP inlet**		140 l/min	37 US Gal/min
	Port P with PVPM/PVPVM mid inlet		230 l/min	61 us gal/min
	Port A/B with pressure compensator		125 l/min	33 US gal/min
Spool travel, standard			+/- 7 mm	+/- 0.28 in
Spool travel, float position		**Proportional range**	+/- 4.8 mm	+/- 0.19 in
		Float Position	+/- 8 mm	+/- 0.32 in
Dead band, flow control spools		**Standard**	+/- 1.5 mm	+/- 0.06 in
		Linear characteristic	+/- 0.8 mm	+/- 0.03 in
Maximum internal leakage at 100 bar (1450 psi) and 21 mm2/s (102 SUS)		**A/B –T, PVB without PVLP**	20 cm3/min	1.85 in3/min
		A/B –T, PVB with PVLP	25 cm3/min	2.15 in3/min
Maximum internal leakage at 200 bar (2900 psi) and 21 mm2/s (102 SUS)		**A/B –T, PVBZ with PO check valves**	1 cm3/min	0.06 in3/min
		A/B –T, PVBZ with PO check valves and PVLP	6 cm3/min	0.37 in3/min
Filtration / maximum contamination according to ISO 4406			23/19/16	
Oil consumption in poot oil reduction valve			0.51 l/min	0.13 US gal/min

Table 6

6.0 Maintenance

Personnel performing maintenance shall be properly trained and qualified maintenance personnel. Personnel responsible for performing these takes must prioritize worker, equipment, and environmental safety.

Before performing any maintenance always ensure that the hydraulic lines are not energized and the system has been depressurized.

If the FMS is equipment with any type of electrical circuits or monitoring systems always ensure that they are deactivated or deenergize. Lockout the circuit if required. Never disconnect a live electrical circuit unless you are certain that the area is free from hazards.

All replacement parts must be KET OEM or meet/exceed OEM specifications to maintain equipment integrity to ensure operations are sustained. All electrical hardware should never be replaced or repaired without first consulting with KET. This goes for electrical and control hardware like circuit breakers, connectors, etc.

⚠**WARNING:** NEVER USE NON-OEM REPLACEMENT PARTS WITHOUT APPROVAL FROM KET. NON-OEM PARTS COULD POTENTIALLY VOID THE EQUIPMENT WARRANTY IF USED.

Steel equipment that rotates and incorporates moving parts has the potential to generate ignition sources like sparks. Risk assessments should always be performed to ensure operations prevent the potential of spark generation.

The equipment should be properly cleaned after every usage. The FMS should be power washed and periodically partial disassembled so that internal components can be properly cleaned as well.

The user/owner should establish maintenance programs to ensure the equipment is maintained and dependable for operations and to avoid costly repairs. This manual will clearly define the minimum maintenance requirements, criteria, and frequencies that should be used as a general guidelines. The equipment may require more frequency in maintenance depending on the environment the equipment is used in and the frequency of usage.

It is recommended to maintain and track all maintenance activities like logs and reports to ensure that the maintenance history is retained and relatively available when required. It is recommended to either use the equipment original OEM serial number or another unique serial number issued by the owner of the equipment to track all records by serial number.

6.0 Maintenance

Maintenance Instructions

PRACTICE SAFETY AT ALL TIMES WHEN SERVICING THIS EQUIPMENT AND USE APPROVED SAFETY METHODS, MATERIAL AND TOOLS. ALWAYS WEAR PROTECTIVE GEAR FOR EYES, HEAD, FEET, AND HANDS.

FREQUENCY OF INSPECTIONS:

All maintenance criteria listed are only recommendations by the manufacturer in accordance with API Recommended Practice 7L. The owner/user of the equipment should develop schedules of inspection based upon experience, the manufactures recommendations, and the following factors.

- Environment
- Load cycles
- Regulatory requirements
- Operating time
- Testing
- Repairs
- Remanufacture

Lubricate the FMS regularly during usage and before storage to prevent corrosion. Use an extreme pressure, multi-purpose, lithium base grease of No. 1 or No. 2 consistency or a lubricant that meets or exceeds MIL-SPEC-A907E.

To ensure optimum performance from the flush mounted spider, perform the prescribed maintenance actions listed in Table 8.

ACTION	FREQUENCY
Clean and grease bowl and slip tapers	Daily During Use
Check latch mechanism for proper function and spring tension	Daily During Use
Check the insert carriers and guide plates are installed correctly	Daily During Use
Grease Back of slip and bowl	Daily During Use
Check insets for wear or damage and replace as necessary	Daily During Use
Grease hinge pins, remove inserts and grease insert slots	Weekly During Use
Check cylinder for leaks and wear, replace as necessary	Weekly During Use
Magnetic Particle Inspection critical areas	Every 6 Months
Clean thoroughly, removing any coatings, disassemble, and MPI 100%	Every 12 Months

Table 7

6.0 Maintenance

FMS Maintenance Locations

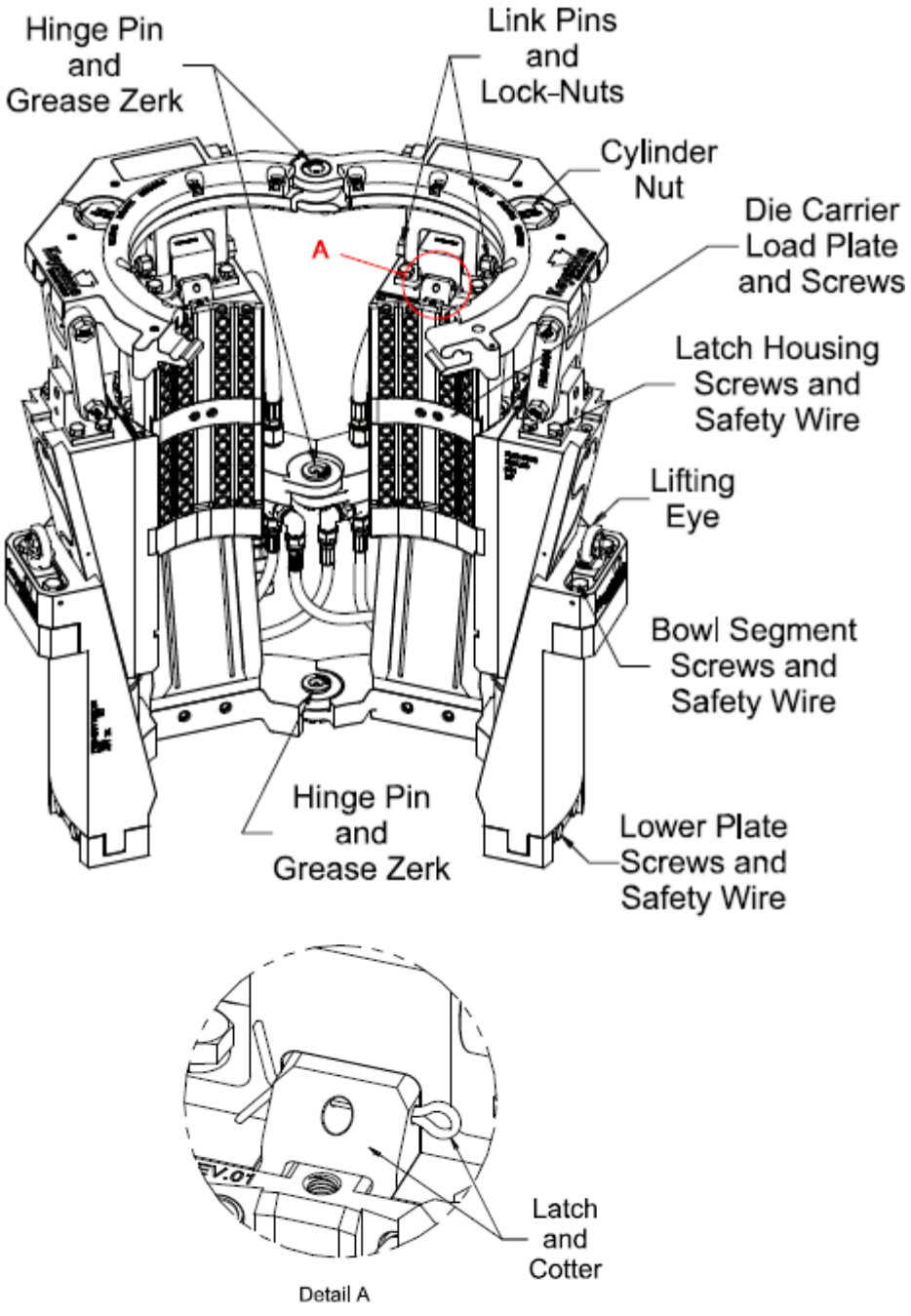


Fig. 33

6.0 Maintenance

FMS Maintenance Locations

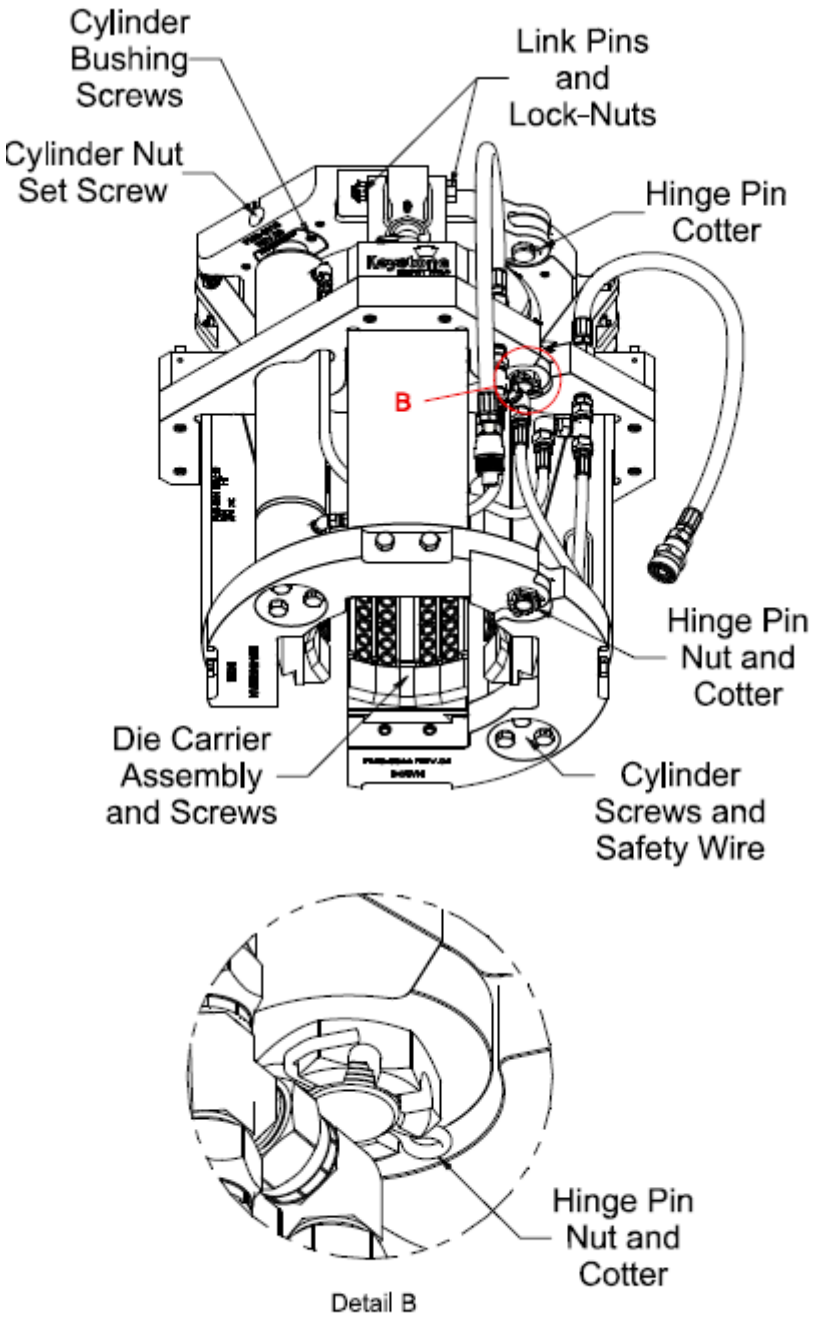
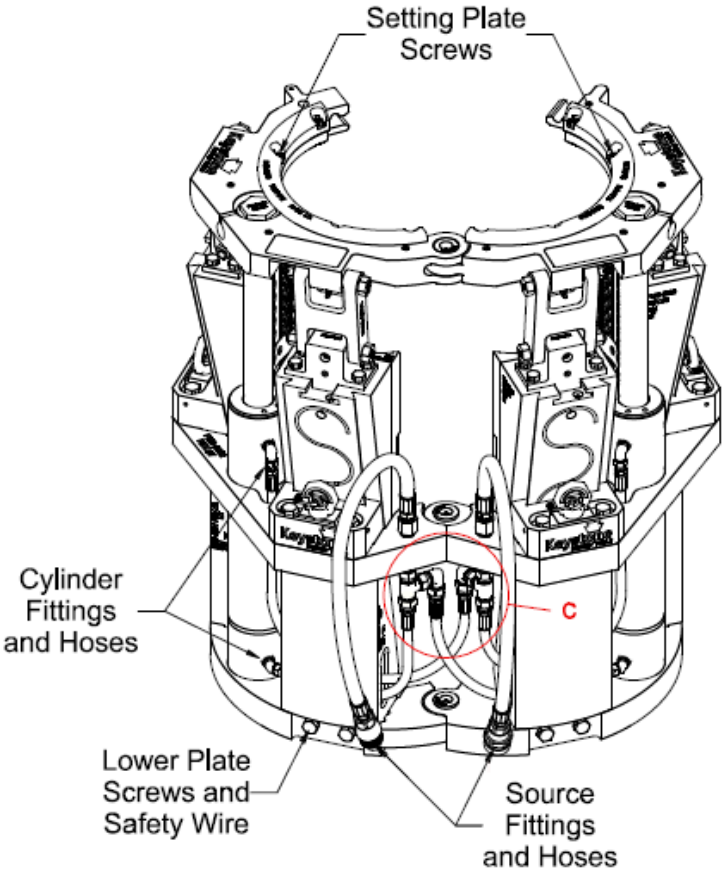


Fig. 34

FMS Maintenance Locations



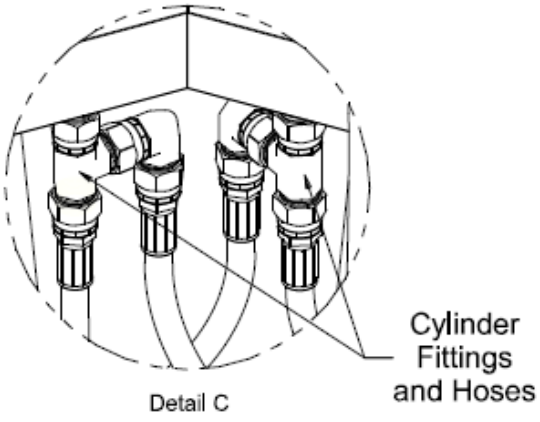


Fig. 35

6.0 Maintenance

Maintenance Instructions

Pre & Post Use Inspection

To ensure optimum performance from the flush mounted spider, perform the prescribed maintenance actions listed in Table 9 before and after each use. See maintenance checklists for assisting scheduled routine inspections.

ACTION	FREQUENCY
Inspect the slips for wear	Pre & Post Use Inspection
Inspect the bowls for wear	Pre & Post Use Inspection
Inspect all insert carrier dovetail slots for wear	Pre & Post Use Inspection
Inspect all hydraulic fittings and quick disconnects	Pre & Post Use Inspection
Inspect cylinder rods for wear and leaks	Pre & Post Use Inspection
Inspect all hydraulic hoses for wear and leaks	Pre & Post Use Inspection
Inspect that all fasteners are torqued and are retained by proper secondary retention	Pre & Post Use Inspection
Inspect leveling plates, carriers, and load carrier plates for signs of wear or deformation	Pre & Post Use Inspection
Grease all grease locations identified in Figures 36, 37, 38	Pre & Post Use Inspection

Table 8

6 Month Inspection

To ensure optimum performance from the flush mounted spider, perform the prescribed maintenance actions listed in Table 10 every 6 months.

ACTION	FREQUENCY
Inspect the slips for wear	6 months
Inspect the bowls for wear	6 months
Inspect leveling plates, carriers, and load carrier plates for signs of wear or deformation	6 months
Inspect all wear data locations verifying requirements are met	6 months
Inspect Cylinders for wear, damage, or leaks	6 months
Conduct MPI inspection of critical areas on load carrying components	6 months

Table 9

5.0 Maintenance

12 Month Inspection

To ensure optimum performance from the flush mounted spider, perform the prescribed maintenance actions listed in Table 11 every 12 months.

ACTION	FREQUENCY
Inspect the slips for wear	12 months
Inspect the bowls for wear	12 months
Inspect leveling plates, carriers, and load carrier plates for signs of wear or deformation	12 months
Inspect all wear data locations verifying requirements are met	12 months
Inspect Cylinders for wear, damage, or leaks	12 months
Conduct 100% MPI inspection on all load carrying components • Bowls • Slips • Insert Carriers • Load Carrier Plates	12 months

Table 10

Insert Replacement

See insert disassembly procedure and steps identified Figures 19-22 in the disassembly and assembly section.

6.0 Maintenance

Lubrication Instructions

The below table identifies other components that need to be lubricated, and the type of lubrication required. Proper lubrication of these components is mandatory to ensure the performance of the equipment is not hindered and component wear is minimized, increasing the life expectancy of the parts and overall effectiveness of the tool.

Location	Lubrication
Slips and Bowl Taper Surfaces (see grease fitting locations Detail C & D in Figure 37)	NLGI No. 3 Lithium or Equivalent
Bolt and Set Screw Threads	Never seize
Pins, Latch Mechanism (see grease fitting locations Detail E, & F in Figure 37)	NLGI No. 2 Lithium or equivalent
Hinge Pins (see grease fitting locations on pins locations Detail G, H, & J Figure 38)	NLGI No. 2 Lithium or equivalent
Link Pins (see grease fitting locations under top plate see Detail A & B in Figure 36)	NLGI No. 2 Lithium or equivalent

Table 11

The above locations have grease fitting locations that needs to be greased before use and daily during use on each slip assembly including the pivot locations on the hinge of the FMS.

⚠**WARNING:** NEVER OPERATE THE FMS WITHOUT PROPOERLY LUBRICATING THE BOWL AND SLIP CONTACT SURFACES (DOVETAILS). FAILURE TO PROPERLY LUBRICATE THESE SURFACES COULD RESULT IN GAULING CAUSING COSTLY REPAIRS.

6.0 Maintenance

Pre-Job & Post Job Inspection Checklist

Pre-Job Inspection

- ❑ Check that the latch has proper spring tension and functions properly without any hesitation or restrictions and verify that the latch is properly securing the (4) insert carriers and (4) cotter pins are installed for secondary retention (see fig. 33 Detail A)
- ❑ Check that the correct insert carriers, inserts, and guide plates are installed.
- ❑ Grease all grease points locations (see fig. 36, 37, & 38).
- ❑ Check that all retaining bolts and nuts are properly secured, that all cotter pins are installed, and safety wire is still securely retaining proper secondary retention.
- ❑ Check that the FMS hinges open and closes properly.
- ❑ Check all hydraulic hoses and fittings for leaks, cuts, or damage.
- ❑ Function test the FMS from "Slip Up" to "Slips Down" 5 to 10 times to ensure it functions properly and that the slips are properly lubricated.

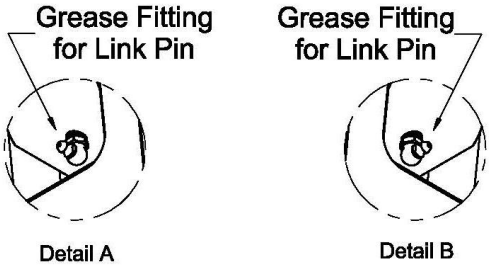
Post Job Inspection

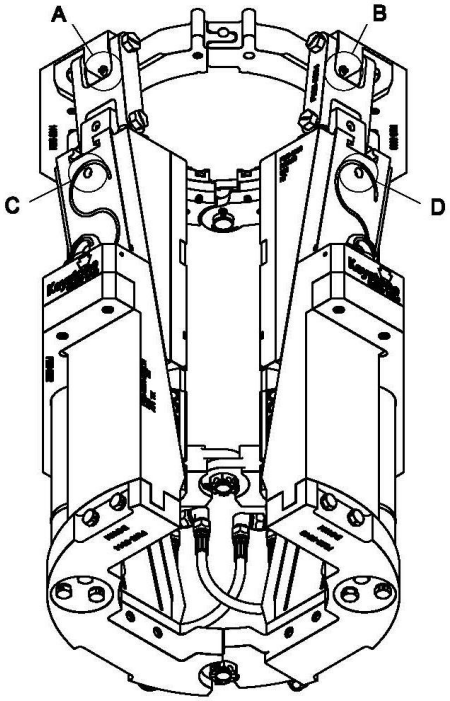
FMS Assembly:

- ❑ Wash and remove any excessive dirt, grease, and fluids.
- ❑ Check the slips and bowls for wear. The slips will need to be in the fully extended position "Slips UP" (see fig. 39).
- ❑ Check the cylinders rods for wear and the seals for any leaks.
- ❑ Check the hydraulic fittings for leaks or damage.
- ❑ Check the hydraulic hose for wear, cuts, and leaks.
- ❑ Check that all retaining bolts and nuts are properly secured, that all cotter pins are installed, and safety wire is still securely retaining proper secondary retention.
- ❑ Grease all grease points and back of slips properly (see fig. 36, 37, & 38).
- ❑ Function test the FMS from "Slip Up" to "Slips Down" 5 to 10 times to ensure it functions properly and that the slips are properly lubricated.
- ❑ Check the bowls for any rolled material and remove if any.

Insert Carriers:

- ❑ Check the inserts for wear, nicks, flats, and/or damage.
- ❑ Remove the inserts, load carrier plates, and check the insert slots for wear or damage (see fig 43).
- ❑ Check the load carrier plates for damaged or excessive wear.


Grease Fitting for Link Pin
Grease Fitting for Link Pin
Detail A
Detail B


A
B
C
D

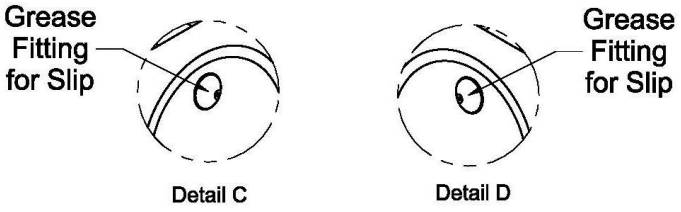
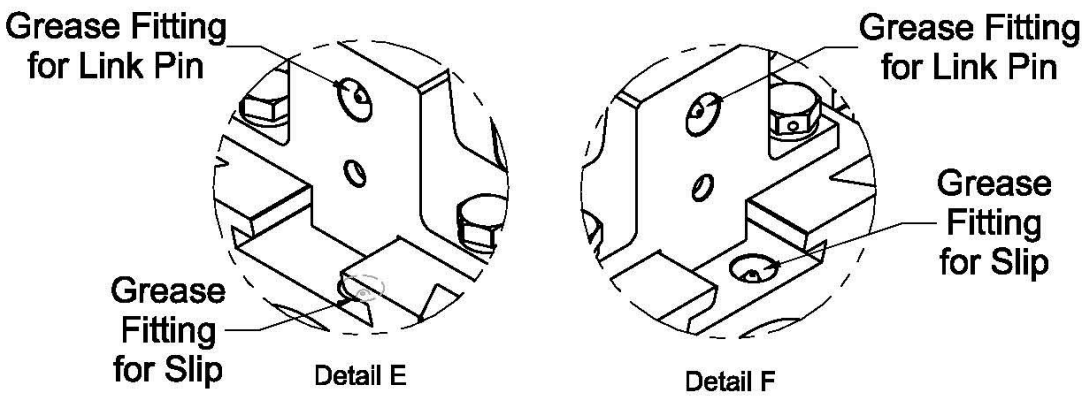

Grease Fitting for Slip
Grease Fitting for Slip
Detail C
Detail D

Fig. 36


Grease Fitting
for Link Pin
Grease
Fitting
for Slip
Detail E
Grease Fitting
for Link Pin
Grease
Fitting
for Slip
Detail F

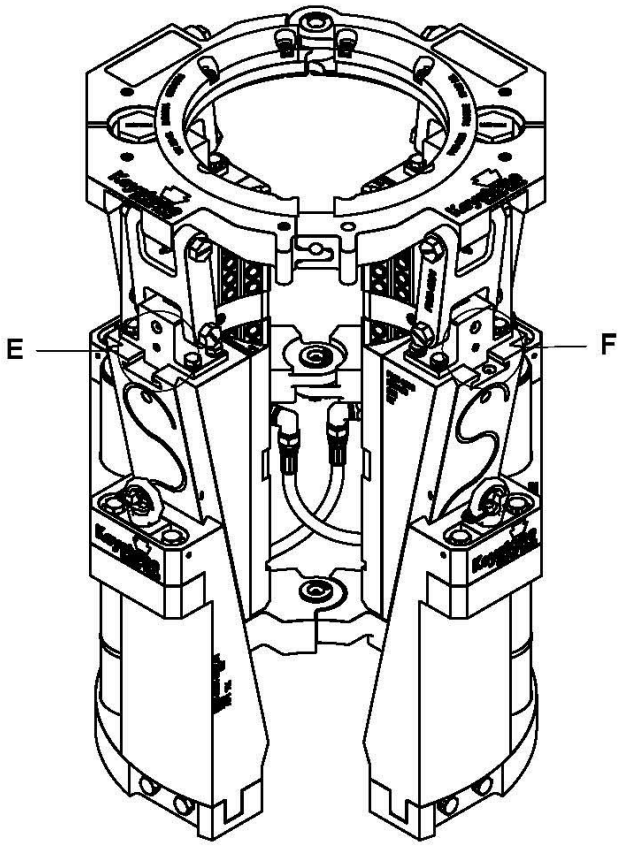

E
F

Fig. 37

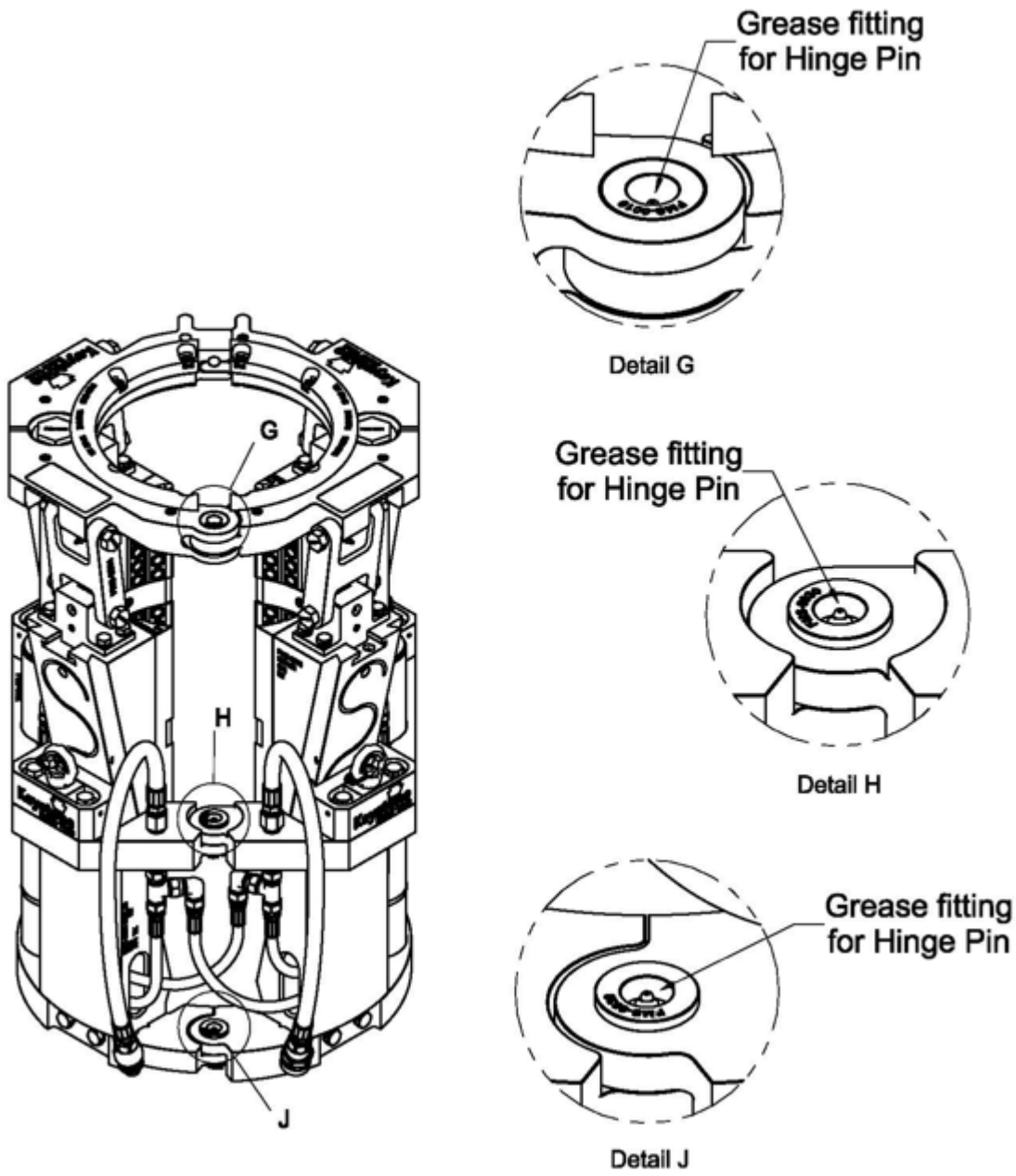

Grease fitting
for Hinge Pin
Detail G
G
H
J
Grease fitting
for Hinge Pin
Detail H
Grease fitting
for Hinge Pin
Detail J

Fig. 38

6.0 Maintenance

Nondestructive Examination/Inspections

Magnetic Particle Inspection

- Magnetic particles examine 100% of all accessible areas of each component as described below:
- Using the wet fluorescent method described in ASTM A275/A275M to perform a 100% magnetic particle examination of all accessible surfaces.
- Only (DC) Direct current and rectified (full wave FW or half wave HW) alternating current shall be used as the power source. Alternative current (AC) is not permitted.
- Inspectors required to be qualified in accordance with American Society of Nondestructive Testing (ASNT) TC-1A (latest edition).

Acceptance Criteria

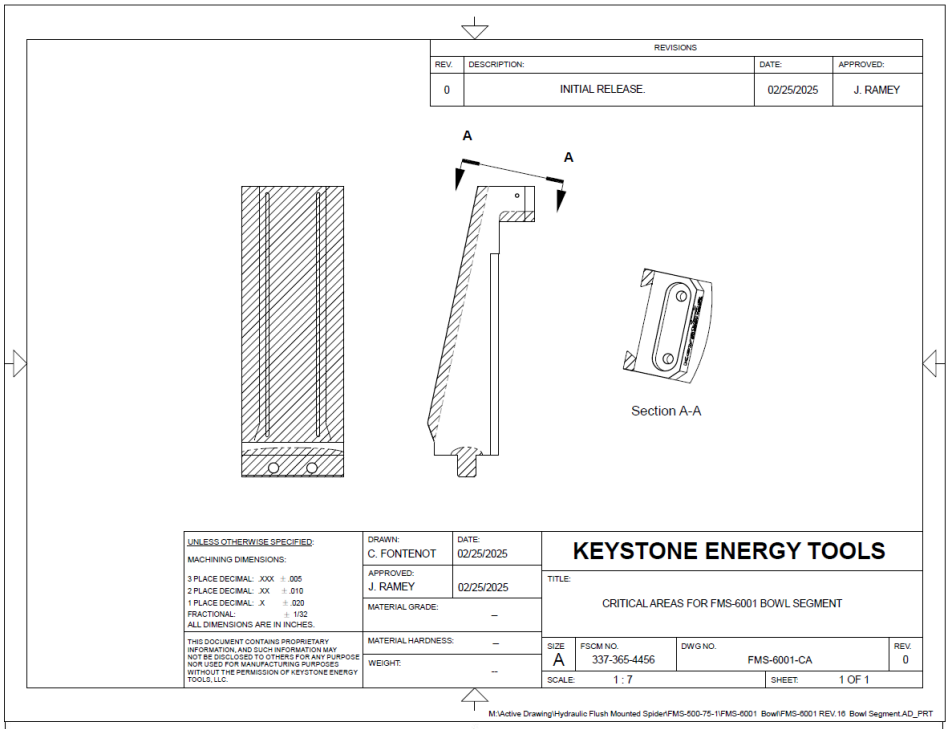
Identified by API 7K:

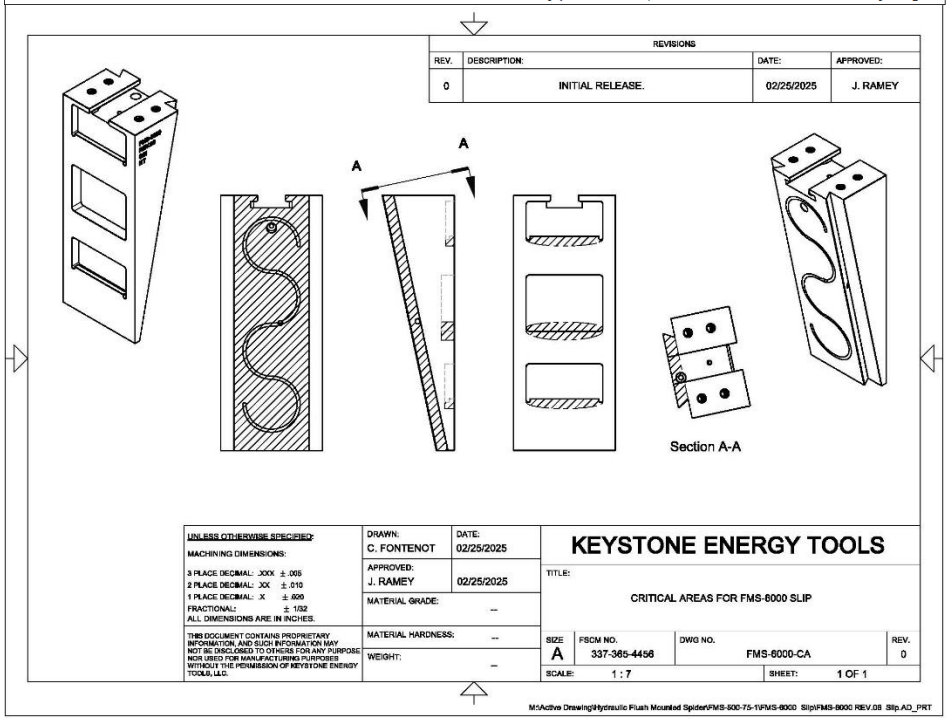
- Report all relevant indications with major dimensions equal to or greater than 5 mm (3/16”),
- No more than 10 relevant indications in any continuous 40 cm^2 (6 in.^2) area,
- No more than 3 relevant indications in a line separated by less than 2 mm (1/16”) edge-to-edge,
- Report results of the examination and supply results with components.

See Critical Area Drawings for each critical component identified in this operational manual.

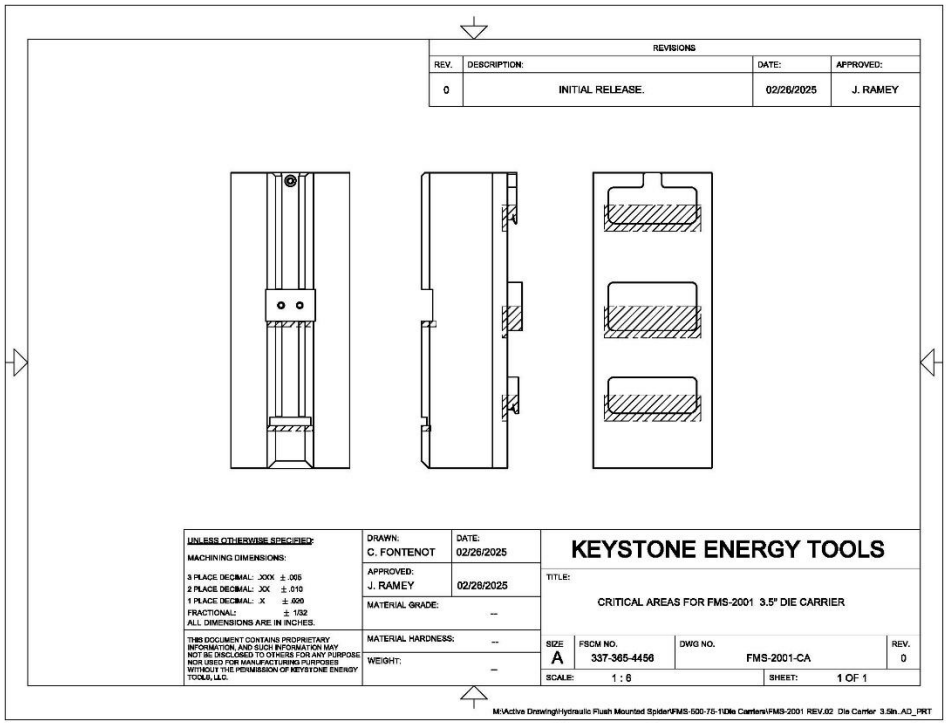
- Bowl Segments
- Slip Segments
- Insert Carrier Segments

7.0 Critical Area Drawings





7.0 Critical Area Drawings



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MATERIAL GRADE: --
MATERIAL HARDNESS: --
WEIGHT: --

KEYSTONE ENERGY TOOLS

TITLE: CRITICAL AREAS FOR FMS-2001 3.5" DIE CARRIER

SIZE	FSCM NO.	DWG NO.	REV.
A	337-365-4456	FMS-2001-CA	0

SCALE: 1 : 6 — SHEET: 1 OF 1

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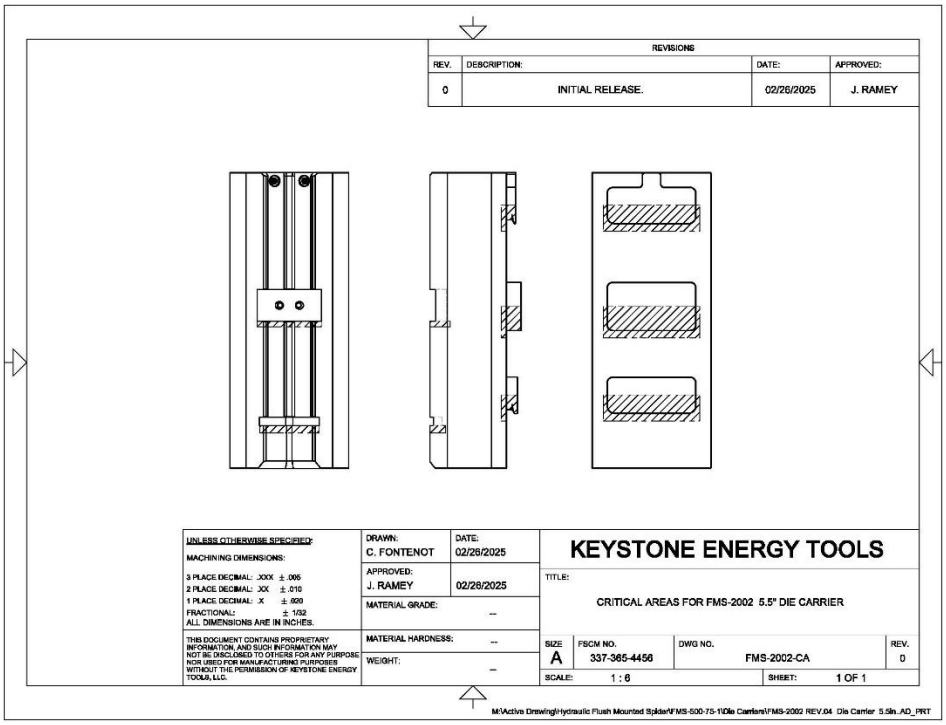

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KEYSTONE ENERGY TOOLS

TITLE: CRITICAL AREAS FOR FMS-2002 5.5" DIE CARRIER

SIZE	FSCM NO.	DWG NO.	REV.
A	337-365-4456	FMS-2002-CA	0

SCALE: 1 : 6 — SHEET: 1 OF 1

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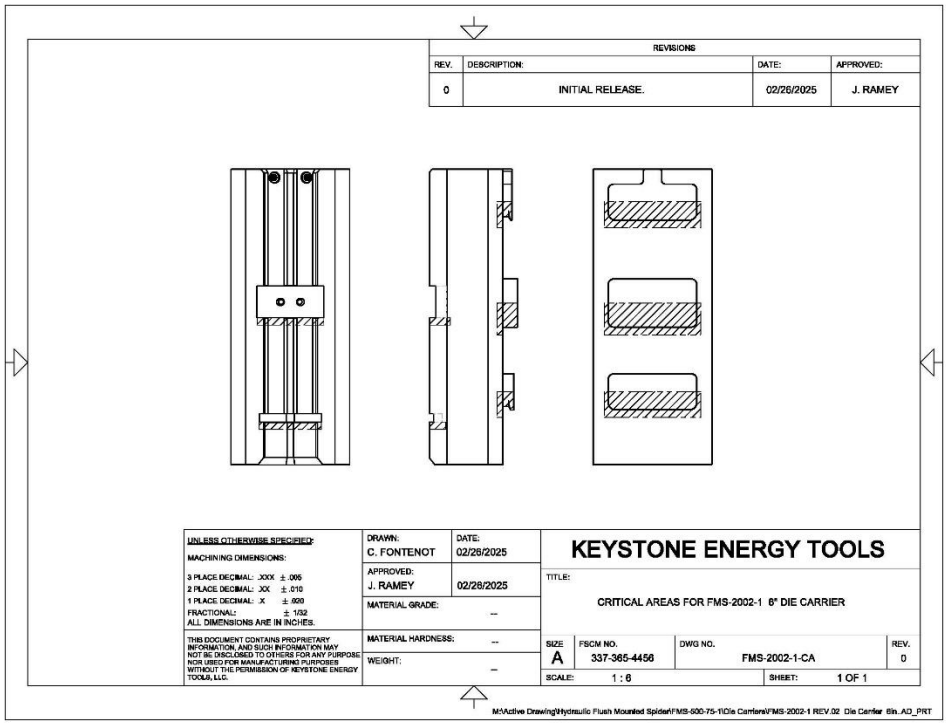
7.0 Critical Area Drawings



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KEYSTONE ENERGY TOOLS

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SIZE	FSCM NO.	DWG NO.	REV.
A	337-365-4456	FMS-2002-1-CA	0

SCALE: 1 : 6 SHEET: 1 OF 1

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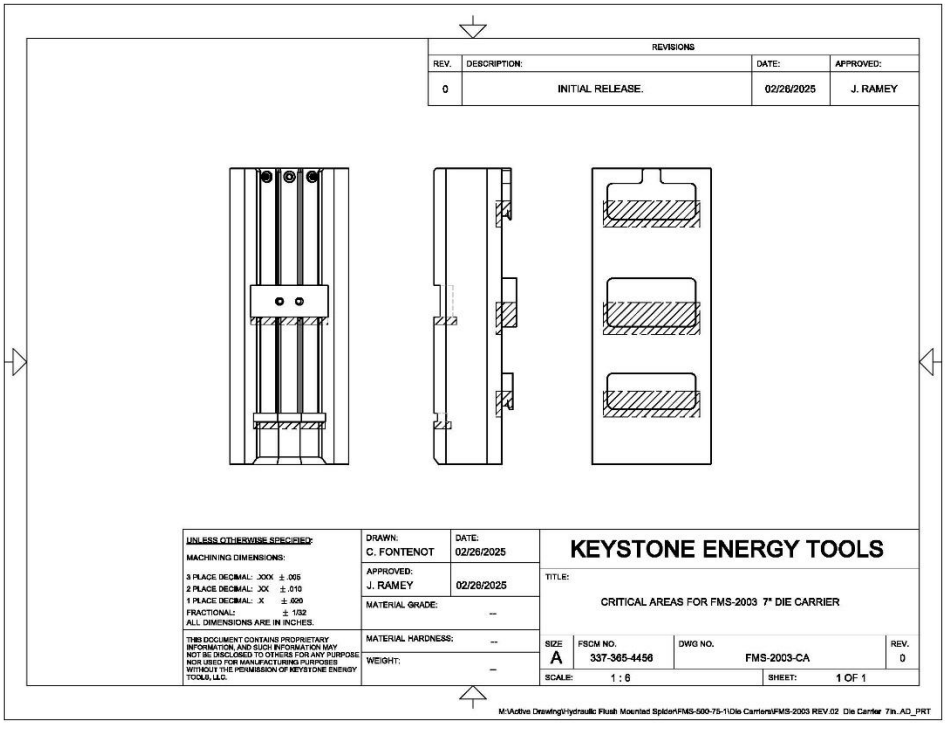

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TITLE: CRITICAL AREAS FOR FMS-2003 7" DIE CARRIER

SIZE	FSCM NO.	DWG NO.	REV.
A	337-365-4456	FMS-2003-CA	0

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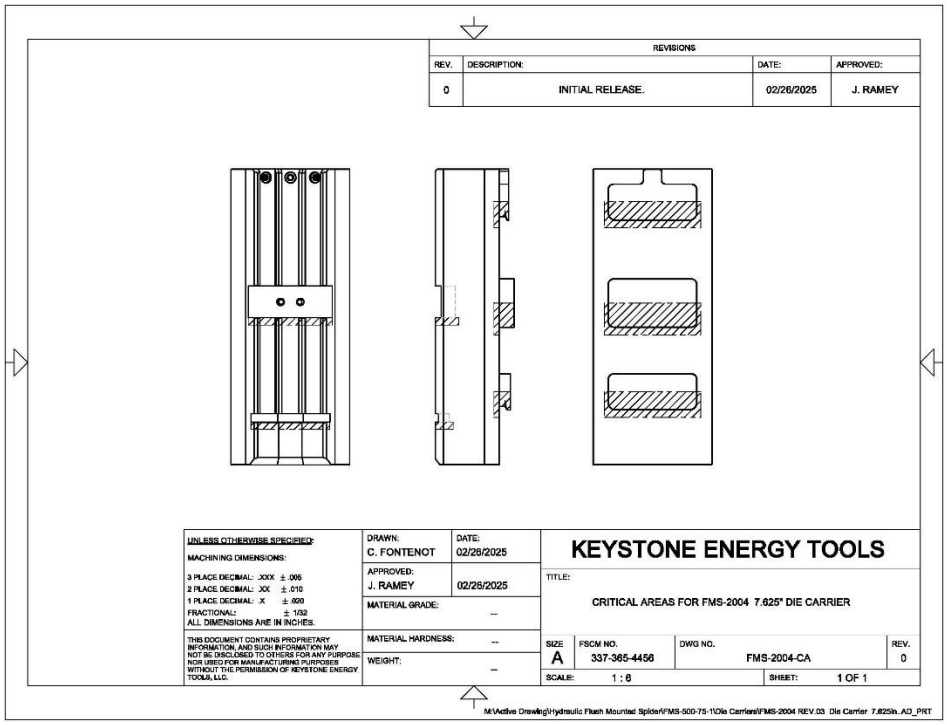
7.0 Critical Area Drawings



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KEYSTONE ENERGY TOOLS

TITLE: CRITICAL AREAS FOR FMS-2004 7.625" DIE CARRIER

SIZE	FSCM NO.	DWG NO.	REV.
A	337-365-4456	FMS-2004-CA	0

SCALE: 1 : 6 SHEET: 1 OF 1

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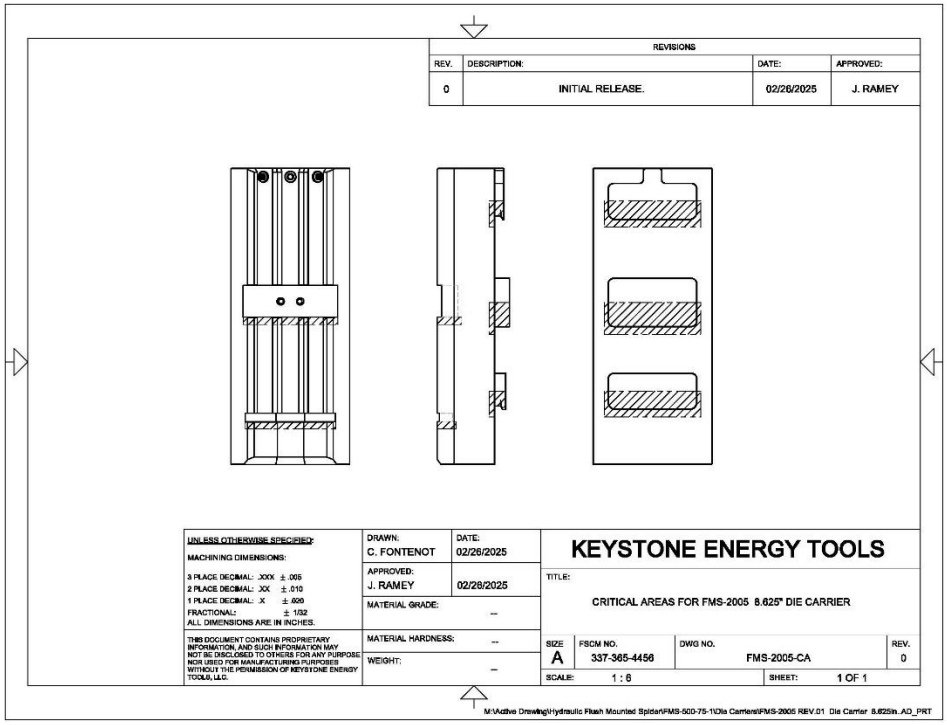

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MATERIAL HARDNESS:	--	
WEIGHT:	--	

KEYSTONE ENERGY TOOLS

TITLE: CRITICAL AREAS FOR FMS-2005 8.625" DIE CARRIER

SIZE	FSCM NO.	DWG NO.	REV.
A	337-365-4456	FMS-2005-CA	0

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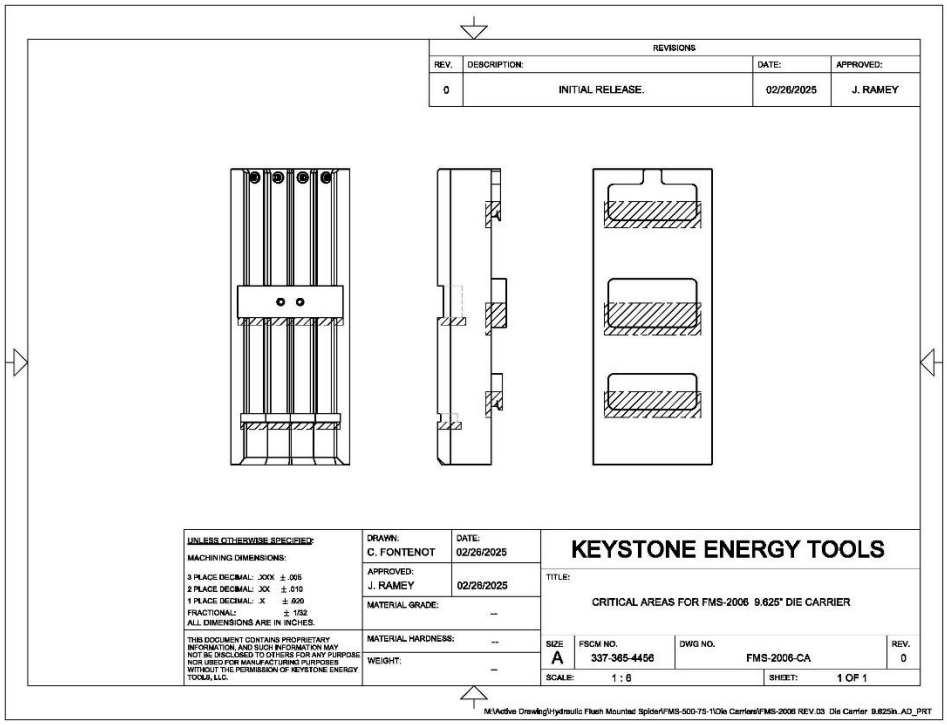
7.0 Critical Area Drawings



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2 PLACE DECIMAL: .XX ± .010
1 PLACE DECIMAL: .X ± .020
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MATERIAL GRADE: --		
MATERIAL HARDNESS: --		SIZE: A / FSCM NO.: 337-365-4456 / DWG NO.: FMS-2006-CA / REV.: 0
WEIGHT: --		SCALE: 1 : 6 / SHEET: 1 OF 1

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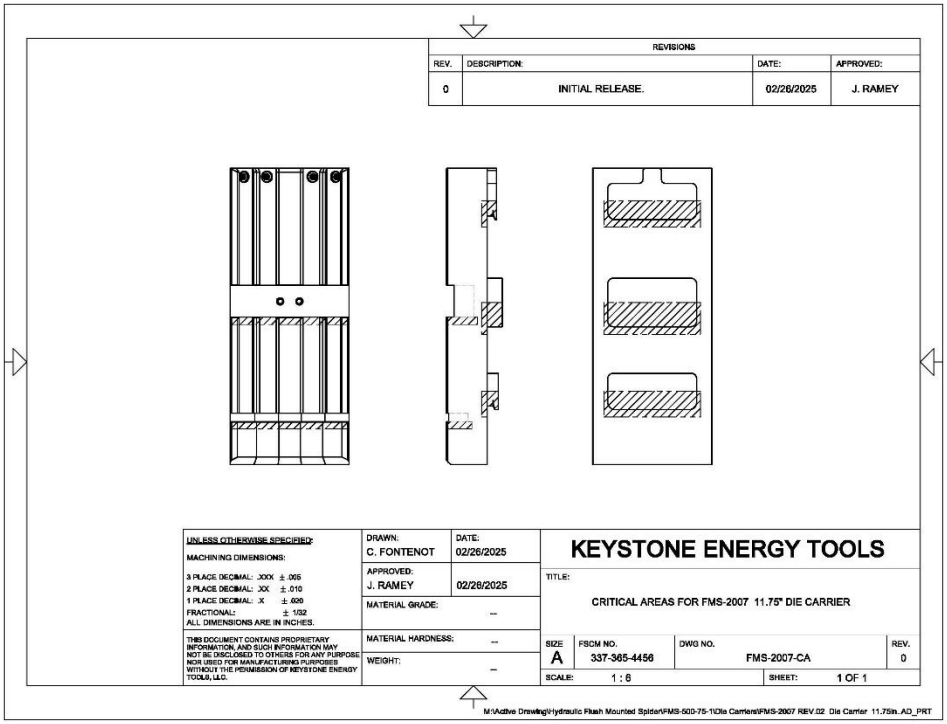

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1 PLACE DECIMAL: .X ± .020
FRACTIONAL: ± 1/32
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MATERIAL GRADE: --		
MATERIAL HARDNESS: --		SIZE: A / FSCM NO.: 337-365-4456 / DWG NO.: FMS-2007-CA / REV.: 0
WEIGHT: --		SCALE: 1 : 6 / SHEET: 1 OF 1

M:\Active Drawing\Hydraulic Flush Mounted Spider\FMS-500-75-1\Die Carriers\FMS-2007 REV.02 Die Carrier 11.75in..AD_PRT

7.0 Critical Area Drawings

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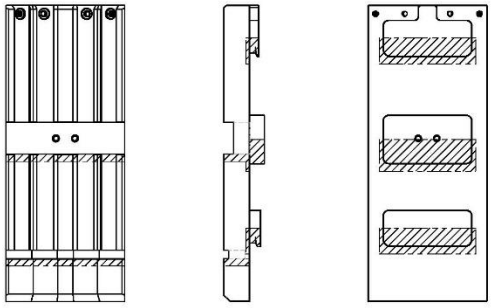

UNLESS OTHERWISE SPECIFIED: MACHINING DIMENSIONS: 3 PLACE DECIMAL: .XXX ± .005 2 PLACE DECIMAL: .XX ± .010 1 PLACE DECIMAL: .X ± .020 FRACTIONAL: ± 1/32 ALL DIMENSIONS ARE IN INCHES.	DRAWN: C. FONTENOT	DATE: 02/26/2025	KEYSTONE ENERGY TOOLS
	APPROVED: J. RAMEY	02/26/2025	TITLE: CRITICAL AREAS FOR FMS-2008 14" DIE CARRIER
	MATERIAL GRADE: --		
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	WEIGHT: --		SCALE: 1 : 8 / SHEET: 1 OF 1

M:\Active Drawing\Hydraulic Flush Mounted Spider\FMS-500-75-1\Die Carriers\FMS-2008 REV.01 Die Carrier 14in. AD_PRT

8.0 Wear Data

Bowl & Slip Criteria

To ensure optimum performance from the flush mounted spider, it is critical to verify that the required wear dimensions are inspected and are within the required tolerances.

There shall be no more than .062” total clearance between the bowl and slip dovetail dimensions.

Example:

Dim A – Dim B = X

X = ≤ .062” in total clearance between the bowl and slip dovetail

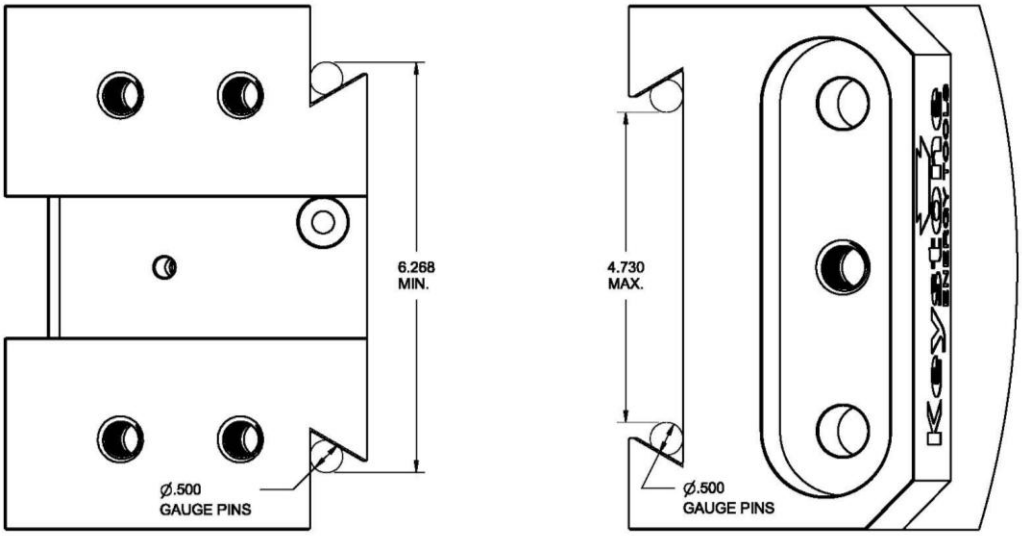


Fig. 39

8.0 Wear Data

Slip Assembly & Linkage Criteria

To ensure optimum performance from the flush mounted spider, it is critical to verify that the required wear dimensions are inspected and are within the required tolerances.

There shall be no more than .032” total clearance between the pins or hole diameters on the linkage system.

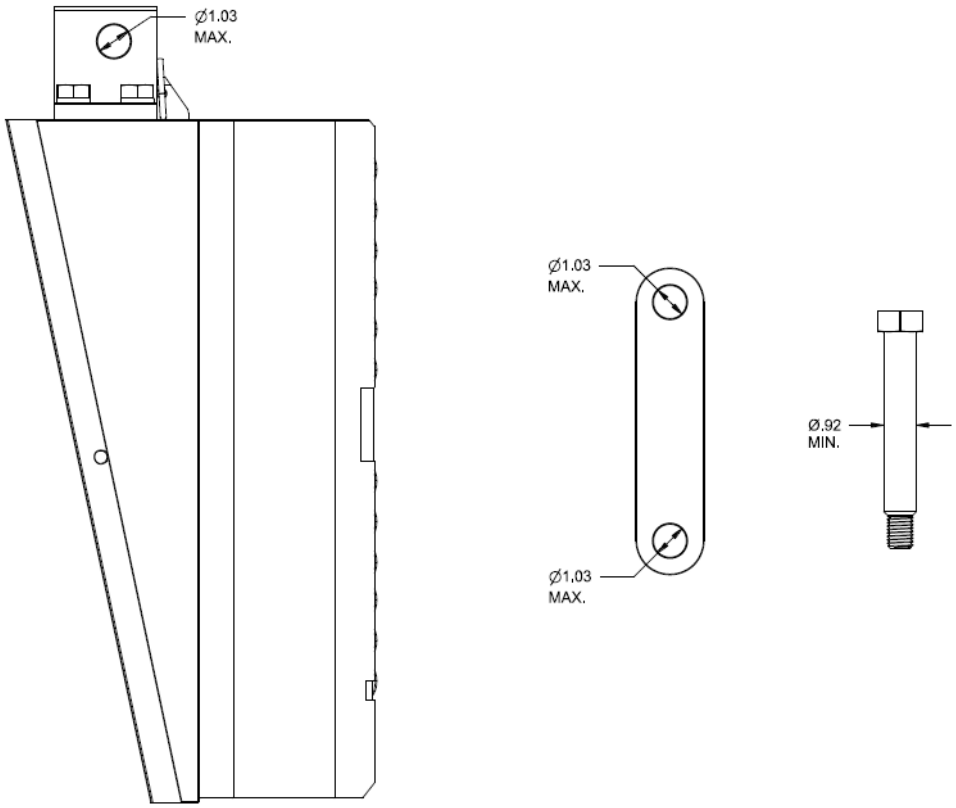


Fig. 40

8.0 Wear Data

Leveling Plate (Left Side) Criteria

To ensure optimum performance from the flush mounted spider, it is critical to verify that the required wear dimensions are inspected and are within the required tolerances.

There shall be no more than .032" total clearance between the pins or hole diameters on the linkage system.

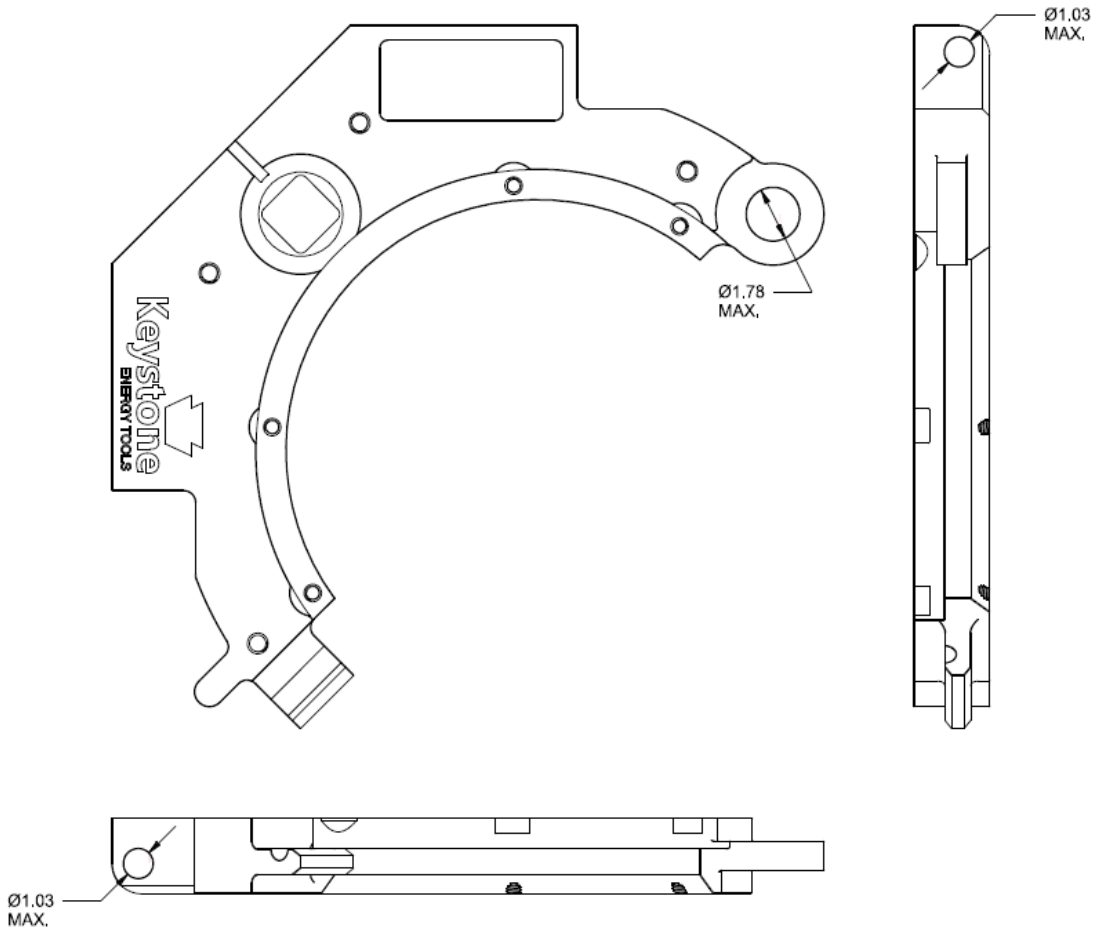


Fig. 41

8.0 Wear Data

Leveling Plate (Right Side) Criteria

To ensure optimum performance from the flush mounted spider, it is critical to verify that the required wear dimensions are inspected and are within the required tolerances.

There shall be no more than .032" total clearance between the pins or hole diameters on the linkage system.

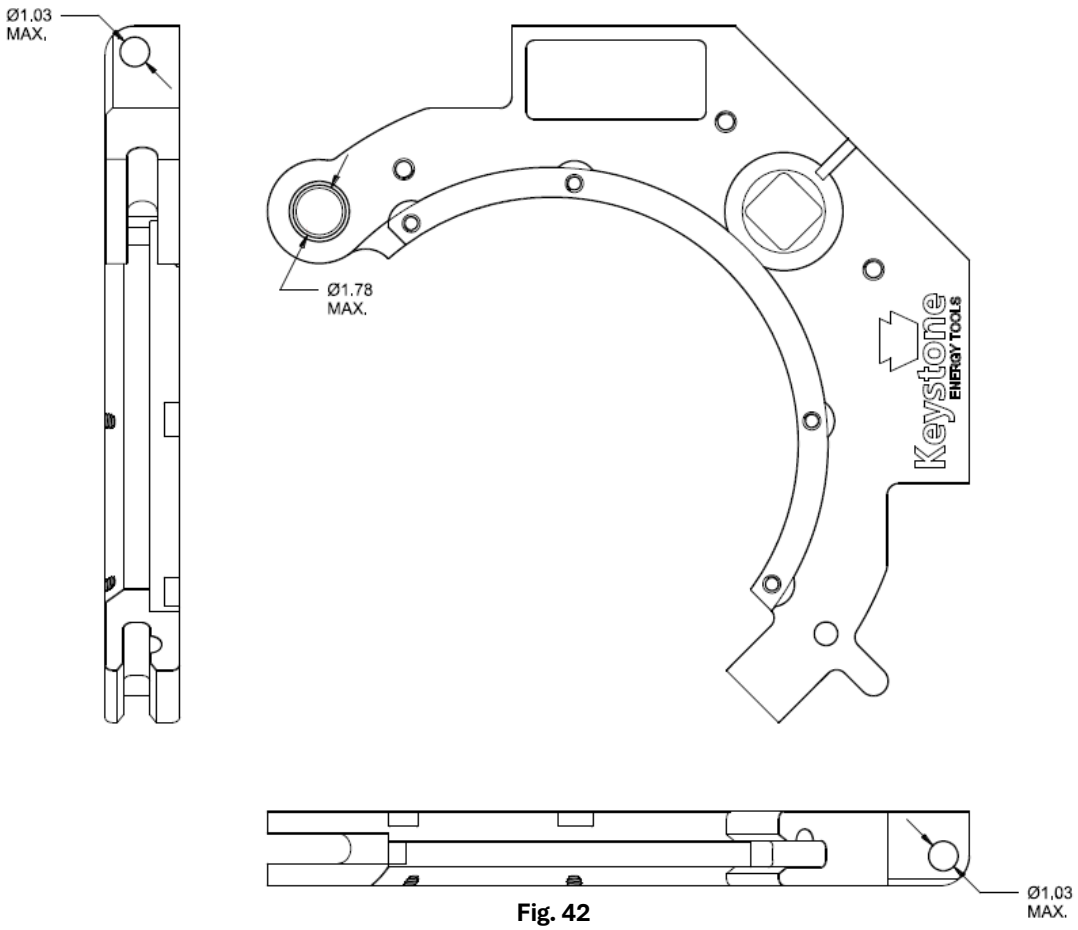


Fig. 42

8.0 Wear Data

Insert Carrier Insert Slot Criteria

To ensure optimum performance from the flush mounted spider, it is critical to verify that the required wear dimensions are inspected and are within the required tolerances.

See the below wear data dimension Max tolerance checked with .250” dowel pins.

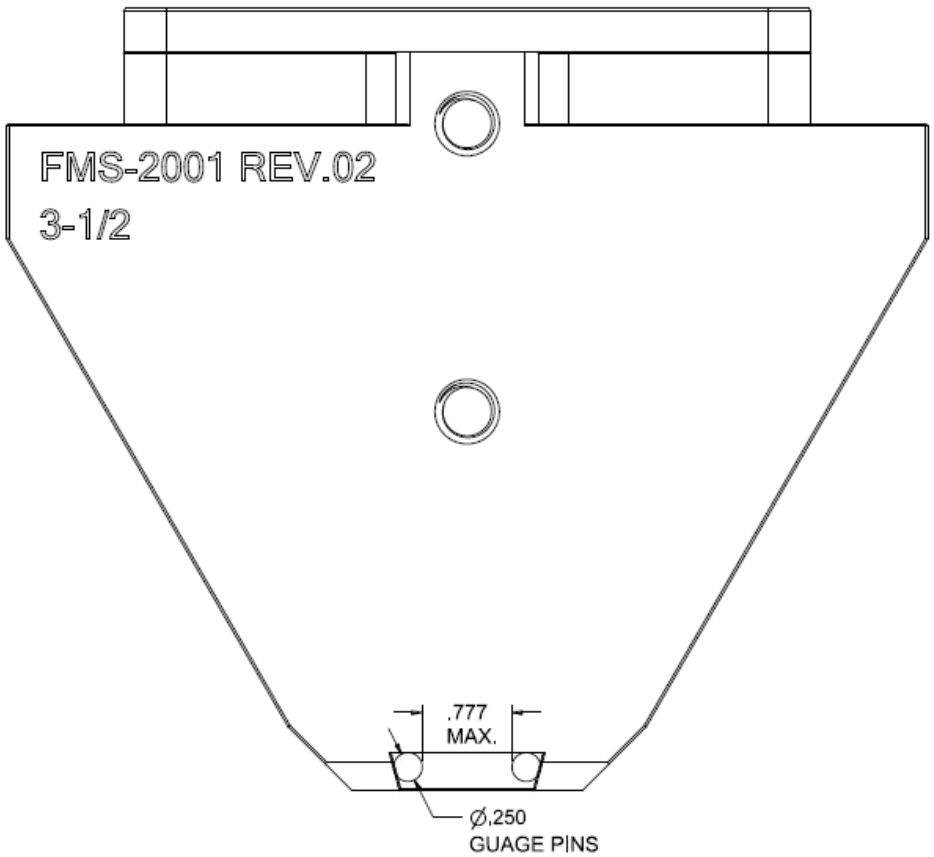


Fig. 43

9.0 Assemblies

FMS-1100
Adapter Bushing "SPLIT" Assembly

FMS-1060
Insert Carrier Lifting Sling

FMS-1050-1
Lifting Sling Assembly

FMS-1100-1
Adapter Bushing "SOLID" Assembly

FMS-6100-LC
Cylinder Lifting Cap

FMS Assembly & Accessories Information		
Description	**Order Part Number**	**Weight**
KET Flush Mounted Spider Assembly	FMS-500-80-1	1988.00 lb.
FMS Assembly API 7K Monogrammed	FMS-500-80-M	1988.00 lb.
FMS Control Console (HPU)	FMS-1000	416.00 lb.
FMS Control Console (EPU)	FMS-1001	416.00 lb.
25' Supply Hose Kit	FMS-1005	40.00 lb.
37-1/2" Rotary Adapter Bushing	FMS-1100	1,551.60 lb.
FMS Lifting Sling Assembly	FMS-1050-1	120.00 lb.
FMS Assembly Bolt Kit	FMS-4100-KIT	18.00 lb.
FMS Hydraulic Assembly Kit	FMS-4000-KIT	16.00 lb.
FMS Latch Puller T-Tool	FMS-6006-PT	1.00 lb.
Insert Carrier Lifting Sling	FMS-1060	17.00 lb.
Cylinder Lifting Cap	FMS-6100-LC	3.03 lb.

Table 12

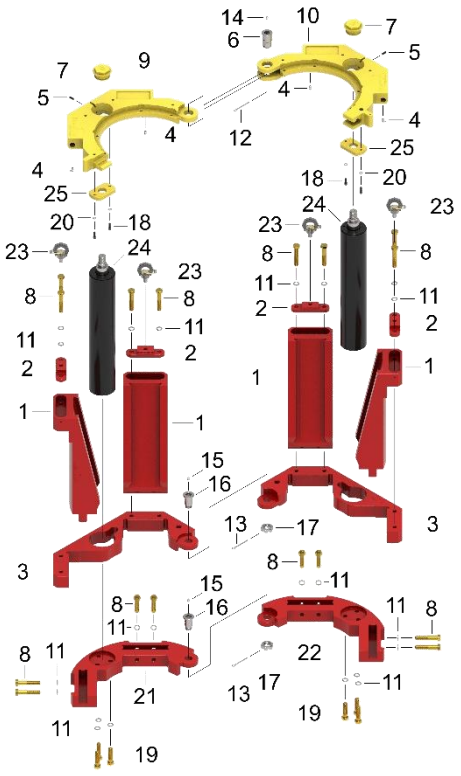
9.0 Assemblies

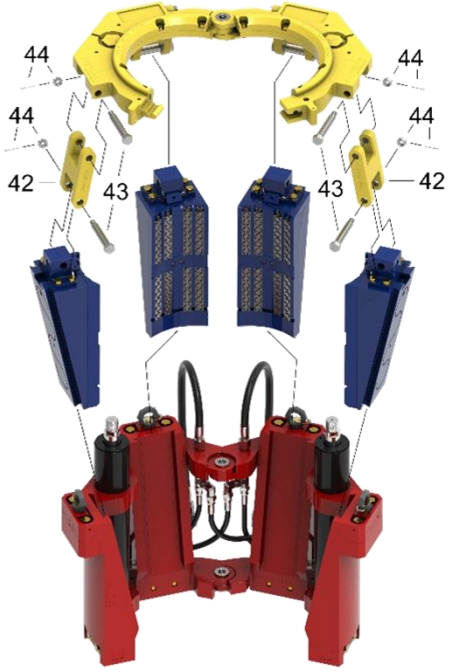



FMS Insert Carriers Assembly, Insert, & Guide Plate Information						
Insert Carrier Size	**Insert Carrier Part #**	**Pipe Size**	**Keystone Insert Part #**	**Qty. Required**	**Load Carrier Plate Part#**	**Guide Plate Part #**
3-1/2"	FMS-2000-1	2-3/8" to 3-1/2"	FMS-INS-2375	16	FMS-3500-LP	FMS-6063
5-1/2“ – DP	FMS-2000-2-DP	4” to 5-1/2”	FMS-INS-4050	32	FMS-5500-LP	FMS-6060
5-1/2"	FMS-2000-2	4" to 4-1/2"	FMS-INS-4050	32	FMS-5500-LP	FMS-6060
		4-1/2" to 5-1/2"	FMS-INS-5500	32	FMS-5500-LP	FMS-6060
6"	FMS-2000-2-1	4 1/2” – 5”	FMS-INS-4550	32	FMS-5000-LP	FMS-6059
		5” – 6”	FMS-INS-6000	32	FMS-5000-LP	FMS-6059
7"	FMS-2000-3	5-1/2" to 6"	FMS-INS-5560	48	FMS-7000-LP	FMS-6057
		6" to 7"	FMS-INS-7000	48	FMS-7000-LP	FMS-6057
7-5/8"	FMS-2000-4	6-1/8" to 6-5/8"	FMS-INS-6166	48	FMS-7625-LP	FMS-6056
		6-5/8" to 7-5/8"	FMS-INS-7625	48	FMS-7625-LP	FMS-6056
8-5/8"	FMS-2000-5	7-1/8" to 7-5/8"	FMS-INS-7176	48	FMS-8625-LP	FMS-6055
		7-5/8" to 8-5/8"	FMS-INS-8625	48	FMS-8625-LP	FMS-6055
9-5/8"	FMS-2000-6	8-1/8" to 8-5/8"	FMS-INS-8186	64	FMS-9625-LP	FMS-6054
		8-5/8" to 9-5/8"	FMS-INS-9625	64	FMS-9625-LP	FMS-6054
11-3/4"	FMS-2000-7	10-1/4" to 10-3/4"	FMS-INS-101107	64	FMS-11750-LP	FMS-6052
		10-3/4" to 11-3/4"	FMS-INS-11750	64	FMS-11750-LP	FMS-6052
14"	FMS-2000-8	12-1/2" to 13"	FMS-INS-12513	64	FMS-14000-LP	FMS-6050
		13" to 14"	FMS-INS-14000	64	FMS-14000-LP	FMS-6050

Table 13

10.0 Parts Breakdown





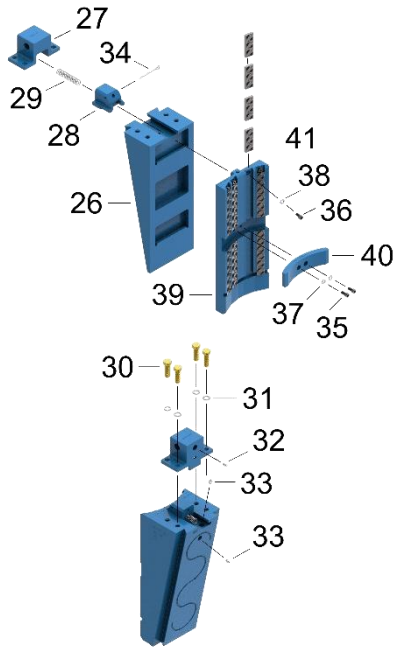
FMS Frame Breakdown

#	Part Number	Description	QTY
1	FMS-6001	Bowl Segment (Matched Set of 4)	1
2	FMS-6001-TC	Top Cap for Bowl Segment	4
3	FMS-6002	Upper Body Plate	2
4	FMS-6008	Grease Zert. F/Link Pin	4
5	FMS-6011-SET	Cylinder Cap Set Screw	2
6	FMS-6010	Top Plate Hinge Pin	1
7	FMS-6011	Cylinder Nut	2
8	FMS-6013	Body Plate Bolt	16
9	FMS-6014	Top Leveling Plate (Left Side)	1
10	FMS-6016	Top Leveling Plate (Right Side)	1
11	FMS-6017	Body Bolt & Cylinder Nut Lock Washer	22
12	FMS-6023	Cotter Pin f/ Top Plate Hinge Pin	1
13	FMS-6023	Cotter Pin f/ Body Hinge Pin	2
14	FMS-6029	Grease Zerk. f/Top Plate Hinge Pin	1
15	FMS-6029	Grease Zerk. f/Body Hinge Pin	2
16	FMS-6030	Hinge pin	2
17	FMS-6031	Nut f/Hinge Pin	2
18	FMS-6034	Cylinder Bushing Retainer Bolt	4
19	FMS-6042	Cylinder Bolt	6
20	FMS-6043	Lock Washer f/Bushing Retainer Bolt	4
21	FMS-6044	Lower Body Plate (Left Side)	1
22	FMS-6045	Lower Body Plate (Right Side)	1
23	FMS-6070	Lifting Eye	4
24	FMS-6100	Hydraulic Cylinder	2
25	FMS-6100-B	Cylinder Rod Bushing	2

FMS Linkage System Breakdown

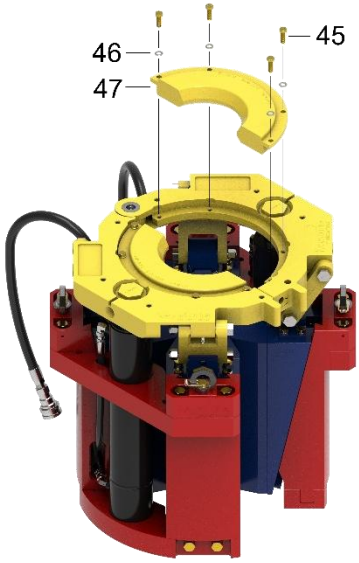
#	Part Number	Description	QTY
42	FMS-6004	Link	4
43	FMS-6018	Link Pin	8
44	FMS-6021	Lock Nut f/Link Pin	8

10.0 Parts Breakdown



FMS Slip, Carrier, & Latch Breakdown

#	Part Number	Description	QTY
26	FMS-6000	Slip Assembly (Matched Set of 4)	1
27	FMS-6005	Latch Housing	4
28	FMS-6006	Latch	4
29	FMS-6007	Latch Spring	4
30	FMS-6020	Bolt f/Latch Housing	16
31	FMS-6022	Lock Washer f/latch Housing Bolt	16
32	FMS-6029	Grease Zerk f/Latch Housing	4
33	FMS-6029	Grease Zerk f/Slip	8
34	FMS-6033	Cotter Pin f/Latch	4
35	FMS-6034	Retainer Bolt f/Load Carrier Plate	8
36	FMS-6034	Insert Retainer Bolt f/Insert Carrier	TBD
37	FMS-6043	Lock Washer f/Load Carrier Retainer Bolt	8
38	FMS-6043	Lock Washer f/Insert Carrier Bolt	TBD
39	See Table 14	Insert Carrier	1
40	See Table 14	Load Carrier Plate	4
41	See Table 14	Load Torque Insert	TBD



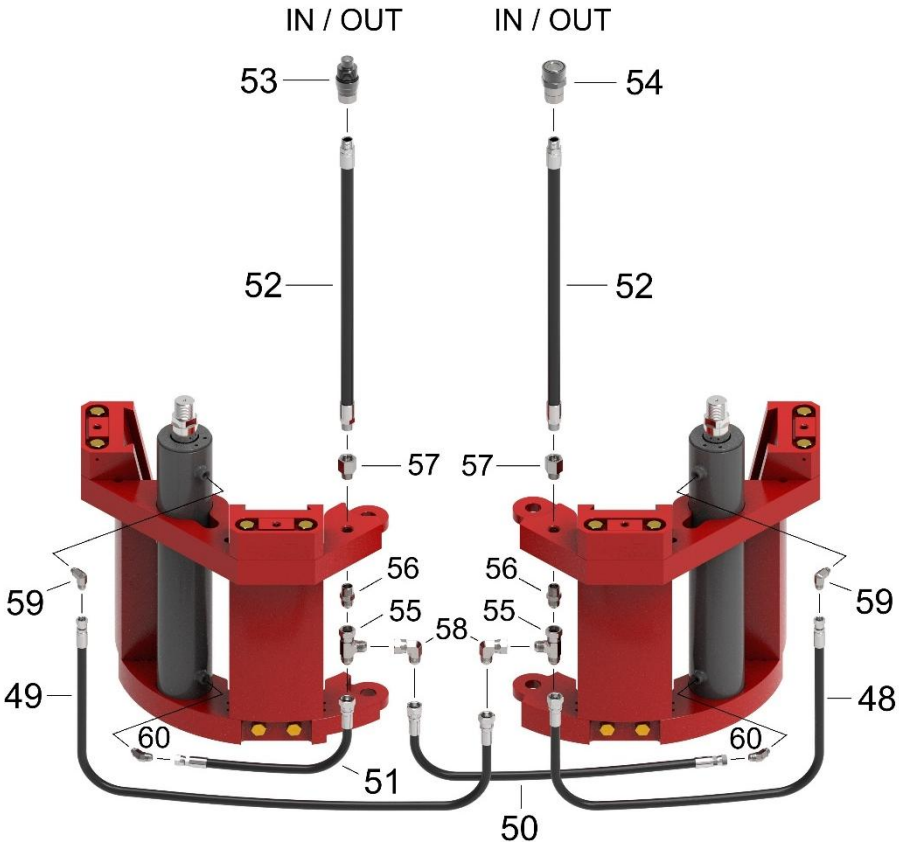
FMS Guide Plate Breakdown

#	Part Number	Description	QTY
45	FMS-6028	Guide Plate Retainer Bolt	8
46	FMS-6046	Lock Washer f/Guide Plate Bolt	8
47	See Below	Guide Plate (See Guide Plate Chart)	1

FMS Guide Plate Order Information

#	Part Number	Description	QTY
47	FMS-6063	2 3/8" – 3 1/2" Guide Plate (1 Set = 2 pcs)	1
47	FMS-6060	4" – 5 1/2" Guide Plate (1 Set = 2 pcs)	1
47	FMS-6059	5" – 6" Guide Plate (1 Set = 2 pcs)	1
47	FMS-6057	5 1/2" – 7" Guide Plate (1 Set = 2 pcs)	1
47	FMS-6056	6 1/8" – 7 5/8" Guide Plate (1 Set = 2 pcs)	1
47	FMS-6055	7 1/8" – 8 5/8" Guide Plate (1 Set = 2 pcs)	1
47	FMS-6054	8 1/8" – 9 5/8" Guide Plate (1 Set = 2 pcs)	1
47	FMS-6052	10 1/4" – 11 3/4" Guide Plate (1 Set = 2 pcs)	1
47	FMS-6050	12 1/2" – 14" Guide Plate (1 Set = 2 pcs)	1

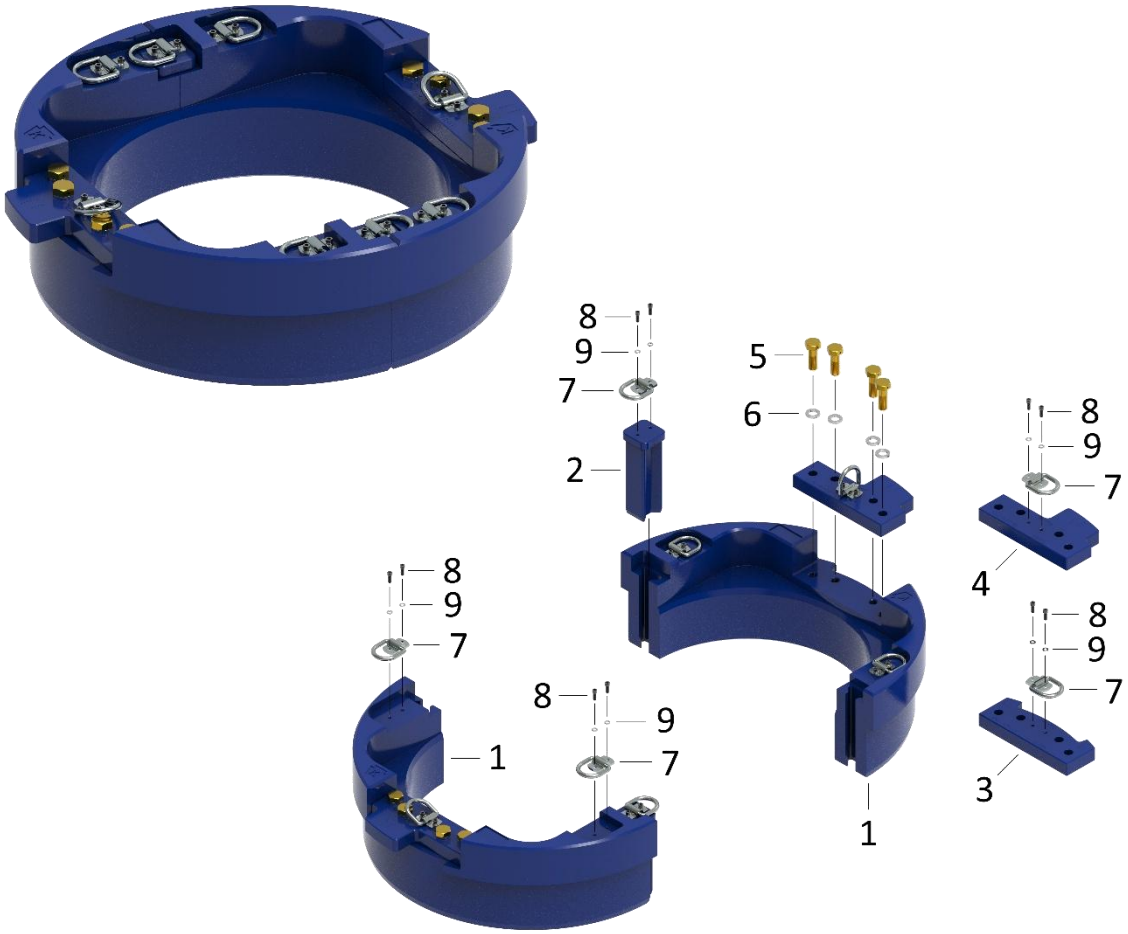
10.0 Parts Breakdown



FMS Hydraulic Component Breakdown

Item #	Part #	Description	QTY
48	FMS-6035	Upper Hydraulic Hose Assembly (Left Side)	1
49	FMS-6036	Upper Hydraulic Hose Assembly (Right Side)	1
50	FMS-6037	Lower Hydraulic Hose Assembly (Left Side)	1
51	FMS-6038	Lower Hydraulic Hose Assembly (Right Side)	1
52	FMS-6039	Supply Hose WHIP	2
53	FMS-6040	Male Quick Disconnect Fitting (Right Side)	1
54	FMS-6041	Female Quick Disconnect Fitting (Left Side)	1
55	FMS-6047	Tee Fitting (Left/Right Side)	2
56	FMS-6049	NPT (Fitting)	2
57	FMS-6072	Expander Fitting (Left/Right Side)	2
58	FMS-6073	Elbow Fitting (Left/Right Side)	2
59	FMS-6074	Upper Cylinder Fitting (Left/Right Side)	2
60	FMS-6075	Lower Cylinder Fitting (Left/Right Side)	2

10.0 Parts Breakdown – Adapter Bushing “Split”



Adapter Bushing Breakdown			
Item #	**Part #**	**Description**	**QTY**
1	FMS-1100	37 1/2” Adapter Bushing	2
2	FMS-1101	Connector Hinge Pin	2
3	FMS-1102	Lug Plate f/EMSCO® Type Rotary	2
4	FMS-1103	Lug Plate f/National® Type Rotary	2
5	FMS-1104	Retainer Bolt f/Lug Plate	8
6	FMS-1105	Lock Washer f/Retainer Bolt	8
7	FMS-1106	Lift Eye f/Adapter Bushing	8
8	FMS-1107	Retainer Bolt f/Lifting Eye on Adapter	16
9	FMS-1108	Lock Washer f/Lift Eye Retainer Bolt	16

10.0 Recommended Spare Parts

FMS Recommended 1 Year Spare Parts			
Item #	**Part #**	**Description**	**Req. QTY**
4	FMS-6008	Grease Zert. F/Link Pin	2
5	FMS-6011-SET	Cylinder Cap Set Screw	1
11	FMS-6017	Body Bolt & Cylinder Nut Lock Washer	4
12	FMS-6023	Cotter Pin f/ Top Plate Hinge Pin	1
13	FMS-6023	Cotter Pin f/ Body Hinge Pin	2
29	FMS-6007	Latch Spring	2
32	FMS-6029	Grease Zerk f/Latch Housing	2
33	FMS-6029	Grease Zerk f/Slip	2
34	FMS-6033	Cotter Pin f/Latch	4
35	FMS-6034	Retainer Bolt f/Load Carrier Plate	8
36	FMS-6034	Insert Retainer Bolt f/Insert Carrier	8
37	FMS-6043	Lock Washer f/Load Carrier Retainer Bolt	8
38	FMS-6043	Lock Washer f/Insert Carrier Bolt	8
43	FMS-6018	Link Pin	2
44	FMS-6021	Lock Nut f/Link Pin	2
45	FMS-6028	Guide Plate Retainer Bolt	4
46	FMS-6046	Lock Washer f/Guide Plate Bolt	4
53	FMS-6040	Male Quick Disconnect Fitting (Right Side)	1
54	FMS-6041	Female Quick Disconnect Fitting (Left Side)	1

11.0 Troubleshooting

Troubleshooting Scenarios	
FMS won't fit inside the rotary or adapter bushing	
a)	Ensure that the FMS is not pivoted open. If the slips were retracted down with enough hydraulic pressure, it may wedge the bottom of the FMS open
b)	If the adapter bushing does not fit into the 37 ½" rotary, then check to verify you are using the correct lug plates.
The FMS SLIP UP and SLIP DOWN are operating opposite of what the controls on the console state	
a)	Verify that the hydraulic hoses are plumbed correctly on the FMS (See Figure 32)
b)	Verify that the fittings on the control console are correct. The Female (FQD) should be on the left and the Male (MQD) should be on the right-hand side of the control panel
c)	Verify that the control lines are run correctly from the Control Console to the FMS
FMS Slips are traveling too slow	
a)	Verify that there are no hydraulic leaks on the FMS hoses, fittings, including the control console
b)	Verify that the tool is properly lubricated
c)	Verify that the cylinders are not leaking or damaged
d)	Verify you have a minimum of 750 PSI on the "SLIP UP" valve in the control console
e)	Verify that you have sufficient hydraulic flow rate, 30 GPM or greater to maintain 3 sec
FMS not maintaining proper torque and/or pipe slipping when torque is applied	
a)	Verify that you are getting proper hydraulic fluid and pressure to the FMS
b)	Verify that the HPU is adequately providing 2,500 PSI to the FMS
c)	Verify that the console shows 2,500 psi on the "SLIP DOWN" pressure valve
d)	Ensure that they Load Torque Inserts are not damaged or built-up with debris and material preventing proper penetration
e)	Verify that the correct insert carrier and inserts are being used, based on the tubular size
f)	Verify that neither one of the cylinders are broken where they meet the leveling plate

Reception, Storage, Transport & Decommissioning

Reception

Check the tool immediately after reception and re-preserve the tool as required (try to have this completed withing 1 month).

Any exposed or non painted metal surfaces should be coated with a rust preventative to prevent any corrosion build up. All equipment should be protected from potential deterioration and damage. Steps should be taken to preserve the equipment from environmental and other factors that could affect its integrity.

Storage

The tool should be stored or palletized in a clean, dry place, and if possible, stored in a climate controlled environmental to avoid all elements. If the tool is to be stored outdoor, then a cargo container would be appropriate to ensure the tool is not exposed to weather conditions. The use a silica gel desiccant to wrap and seal the equipment is recommended to be used to reduce the humidity during storage period.

Preserve the tool by greasing all areas & ensuring the tool is fully lubricated, defined in the maintenance requirements of this manual. Secondly, any excess grease or lubricants shall be removed before being put into storage. It is recommended that the use of anti-corrosive agents be used on all external surfaces.

During storage, the tool shall still be inspected annually per inspection requirements in the user's manual. Before the tool should be put into service, the tool is required to be inspected and tested.

Transport

When lifting the tool do so only by using its designated lifting points. The best way of transporting the tool is in its original palletized or crated state. Ensure the tool is banded down accordingly to prevent the possibility of potential dropped objects and broken shipments that could potential cause damaged to the equipment.

Decommissioning

The tool may contain grease, steel, rubbers, plastic, stainless steel, mild steel and several assembled components with undefined consistency or mixtures. The tool can be contaminated with drilling fluids, hydraulic fluids and preservatives. After the tool is decommissioned, it is recommended to disassemble the tool in a place where waste fluids can be contained and properly disposed of.

⚠**WARNING:** any hydraulic fluids, mud, or grease are potentially unsafe when in contact with the skin. Always wear gloves and safety goggles when disassembling the tool.

1. Clean the tool with a steam cleaner.
2. It is recommended to disassemble the tool in a place where drainage for waste fluids is possible.

RELATED OR REFERENCE DOCUMENTS

The following reference documents are required for the operation and maintenance of the equipment described in this manual. For the most up-to-date information, the latest edition of each reference document, including any amendments, shall apply.

- KET Document No.: OP-50 - *FMS-Position Monitoring System w/Lights Procedure Manual*
- KET Document No.: OP-51 - *FMS-Position Monitoring System w/Rig Integration Procedure Manual*
- KET Document No.: 2L-SCC TEM - *FMS Control Console Operation Manual*
- KET Document No GOM-OM-1.0 - *E-HPU Electric-Hydraulic Power Unit*
- API Specification 7K - *Drilling and Well-Servicing Equipment*
- API Specification 7L - *Procedures for Inspection, Maintenance, Repair, and Remanufacture of Drilling Equipment*
- ASME B30.9 – *Slings*
- ANSI/ASME B30.10 – *Hooks*
- ANSI/ASME B30.25 – *Scrap and Material Handlers*
- MIL-SPEC-A907E – *Antiseize Thread Compound, High Temperature*
- ASTM A275/A275M – *Standard Practice for Magnetic Particle Examination of Steel Forgings*
- ASNT-TC-1A – *Personnel Qualification and Certification in Nondestructive Testing*

CERTIFICATE OF WARRANTY AND GUARANTEE OF QUALITY

KET warrants all materials and products manufactured to be free from defects in material and workmanship, under normal use and service, when installed, used, and serviced in the manner provided and intended by the seller for a period of twelve (12) months after delivery. Seller's obligation under this warranty is expressly limited to repair or replacement, at its option, of any materials or products, returned to the seller's plant in Broussard, Louisiana and which are determined by the seller to be defective. All freight charges for return and reshipment shall be paid by the customer. A new warranty period shall not be established for repaired or replaced material or products; such items shall remain under warranty only for the remainder of the warranty period on the original materials or products. This is the sole warranty of the seller and no other warranty is either expressed or implied, in fact or by law, including any warranty as to the merchantability or fitness for a particular use or purpose.

In case of goods or parts not wholly of seller's manufacture, seller shall make available to the customer whatever warranty or guarantee is extended to seller for such goods or parts by the supplier or manufacturer thereof.

Seller will not assume responsibility or liability for any repairs, rebuilding, welding or heat treating done to its material or products outside of seller's plant, such work shall void all warranties. All parts used in the manufacture and /or final assembly of seller's materials or products are necessary for both safety and operational performance. Omission of any part or failure to replace any worn part may result in the malfunction and a consequent safety hazard for which seller disclaims any responsibility or liability for injuries or damage as a result thereof.

Buyer's sole and only remedy in regard to any defective materials or products shall be the repair or replacement thereof as herein provided, and seller shall not be liable for any consequential, special, incidental or punitive damages resulting from or caused by any defective materials, products or supplies.

REVISION HISTORY

Revision History

Rev	Date	Changes	Revised By
0	08/29/2024	Original release (Prototype)	Cody H.
01	11/25/2024	Added control console parameters removed reference to 350 Ton version	Cody H.
02	02/13/2025	Updated rendering of FMS on cover page	Cody H.
03	02/28/2025	Updated All sections adding wear data, maintenance procedures, BOMs, ordering information etc.	Cody H.
04	03/06/2025	Added disassembly and assembly illustrations and procedures	Cody H.
05	03/28/2055	Added exploded views, ordering information & accessories	Cody H.
06	05/23/2025	Updated Diameter Full Open on Table 5 to Fractions	Cody H.
07	06/01/2025	Updated safety information	Cody H.
08	08/11/2025	Added Annex A, Table of Contents, Troubleshooting Section	Cody H.
09	08/13/2025	Added Annex B	Cody H.
10	08/14/2025	Removed Annex A & B; created their own Ops Manuals	Cody H.
11	11/19/2025	Added pre-job & post-job inspection checklist.	Cody H.
12	12/02/2025	Updated torque specs for bolt tensioning & added disclaimer message for printed and translated documents being uncontrolled	Cody H.
13	02/06/2026	Removed Table 6, renumbered tables and revised new table 6 (previous table 7), added statements and warning about maintaining proper hydraulic fluid operating temperatures.	Cody H.
14	02/10/2026	Added 4 ½" Carrier Assembly to Table 13 and added insert and guide plate usage information in Table 5, removed solid adapter bushing	Cody H.
15	03/03/2026	Removed 4 ½" Carrier Assembly and added 5 ½" – DP carrier assembly f/drill pipe, updated Table 3 and Table 5.	Cody H.
16	03/19/2026	Added leveling plate installation pin usage instructions Fig. 8, 9, 10, adjust all figure numbers, and revised table of contents.	Cody H.
17	4/24/2026	Updated flow requirements to 10 GPM min, >30 GPM Ideal in hydraulic section and troubleshooting	Jarret D.
18	04/30/2026	Updated troubleshooting section adding scenarios for when FMS is not achieving proper torque	Cody H.

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