

Addendum 2  
April 2006

# **Procedures for Inspection, Maintenance, Repair and Remanufacture of Drilling Equipment**

API RECOMMENDED PRACTICE 7L  
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# Procedures for Inspection, Maintenance, Repair and Remanufacture of Drilling Equipment

Replace Appendix A with the following:

## **APPENDIX A—RECOMMENDED PRACTICE FOR OPERATING LIMITS, INSPECTION, CARE, AND USE OF CEMENT HOSE, DRILLING MUD VIBRATOR AND JUMPER HOSE, AND ROTARY HOSE**

This standard covers all types of hoses specified in clause 9.10 of API Spec 7K. The definitions of terms contained in clauses 3.0 and 9.10.1 of API Spec 7K shall apply.

### **A.1 Hose length**

#### **A.1.1 ROTARY HOSE LENGTH**

In order to avoid kinking rotary hose, the length of hose and height of standpipe should be such that while raising or lowering the traveling equipment, the bending radius of the hose will not be less than the value of the Minimum Bending Radius (MBR) provided in Table 7 and C.1 of API Spec 7K at the swivel when the traveling equipment is in its lowest drilling position and at the standpipe when the traveling equipment is in its highest drilling position. The recommended length of rotary hose is derived by the following equation (see Figure A.1).

$$L_H = L_T/2 + \pi R + 2C + S \quad (\text{A.1})$$

where

$L_H$  = length of hose, m (ft)

$L_T$  = length of hose travel, m (ft)

$R$  = minimum radius of bending of hose (see API Spec 7K, Table 7 and C.1 for MBR value). Note: The MBR for certain hoses may be less than the value provided in this table, m (ft)

$C$  = coupling length, m (ft)

$S$  = 0.3 m (1ft) allowance for hose length tolerance and contraction when internal pressure is applied (see API Spec 7K, clause 9.10.5)

Whenever it is necessary to operate with hoses that do not meet the optimum length requirements derived from the formula above, the user should select a hose that is longer than the optimum length. In these cases, the user should determine whether a longer hose could cause safety hazards by interfering with personnel on the drill floor. If such is the case, the user should make adjustments to either or both the height of the standpipe gooseneck and the hose termination on the traveling equipment, and repeat the calculations with the formula provided until the optimum hose length to be utilized is determined.

#### **A.1.2 CHANGES TO HOSE LENGTH AS A RESULT OF PRESSURIZATION**

The overall length of hoses at atmospheric pressure will probably change as pressure is applied (see clause 9.10.4 and 9.10.5 of API Spec 7K). The user shall ensure that sufficient hose length is provided between connection points to avoid overstressing the hose when it is under pressure.

## A.2 Mud standpipe height

The recommended standpipe height is derived by calculation using the following equation (see Figure A.1).

$$H_s = L_T/2 + Z \quad (\text{A-2})$$

where

$H_s$  = vertical height of standpipe, m (ft)

$L_T$  = length of hose travel, m (ft)

$Z$  = height, m (ft), from the top of the derrick floor to the end of hose at the swivel when the swivel is in its lowest drilling position

Note: When the actual length of hose is greater than the length calculated in A.2, the standpipe height should be increased by one-half the difference between the actual length and the calculated length.

## A.3 Hose end connections

Clause 9.10.6.2 of API Spec 7K specifies that hose end connections may be affixed to hose couplings with line pipe threads per API Spec 5B for hose assemblies with a working pressure rating of 34.5 MPa (5,000 psi) or less. For rotary hose assemblies with a working pressure greater than 34.5 MPa (5000 psi) no threads of any kind may be utilized to affix the end connections to the hose coupling. The user should be aware that in certain applications where there is considerably more hose movement during operation, such as on floating offshore rigs, cyclic bending stresses have caused fatigue failures at the last engaged thread between the end connection and the hose coupling when such threads are of the pressure-sealing type, such as line pipe threads specified by API Spec 5B. Therefore, the user should consider alternatives to the use of line pipe threads to join the end connection to the hose coupling for these applications. As such, it is recommended that the user specify the end connection to be affixed to the hose coupling by butt-welding in the purchase agreement for any hose with a working pressure specified in Table 7 and C.1 of API Spec 7K. Alternatively, if the manufacturer can provide it, an “integral” hose coupling/end connection may be specified by the user in the purchase agreement. Such “integral” hose coupling/end connections are manufactured from a single piece of material. Hose assemblies installed onto the swivel gooseneck and onto the standpipe should be as nearly tangential as possible. The use of a standard connection on the swivel gooseneck (see Clause 5 of API Spec 8A, clause 7.2.1, Figure 2, or API Spec 8C, clause 9.9.4.1, Figure 5) will ensure this relationship. The angle of the end of the standpipe gooseneck should be 15 degrees from the vertical, and oriented toward the vertical line of travel of the hose connection point on the swivel.

## A.4 Handling

In order to minimize the possibility of kinking the hose during crating or uncrating, the crate should be rotated as the hose is uncoiled out of or coiled back into the crate. When handling the hose on and off the drill floor, it should be kept as straight as possible, and should not be handled with a sling hitched to the middle of the hose. The end connections of the hose should always be protected from damage due to sliding, abrading, or striking against objects. Special carriers may be devised to lift the hose from its mid-body to ensure that any bends induced in the hose while lifting and transporting are not less than the Minimum Bending Radius (MBR) specified in API Spec 7K, Table 7 and C.1. Whenever a hose has been removed from service and set aside for any reason, it should be protected from damage.

## A.5 Twisting

All hoses covered by this standard should not be intentionally twisted during installation, because each layer of reinforcement is fitted in an alternating right-hand and left-hand helical path around the hose for its entire length. Therefore, if the hose is twisted in one direction, one layer of reinforcement contracts while the other expands. Thereafter, a hose that is twisted and subsequently subjected to pressure and/or bending, permanent damage to the hose will result that will affect its pressure integrity and shorten its useful life. Twisting rotary hose is sometimes employed to force the hose away from the traveling equipment or other interferences in the derrick to avoid contact, snagging, or abrasion. This practice should always be avoided. If the hose interferes with the derrick or mast structure or other objects, the standpipe should be repositioned to avoid these interferences (Note: moving the standpipe may require a hose of a different length to be used per the formula in clause A.2). Alternatively, the objects that the hose is coming into contact with should be repositioned. In cases where a flanged hose end connection is provided that requires the hose to be twisted to align the bolt holes, the other end of the hose should be fitted with an end connection that does not

require a fixed or specific radial orientation in order to be mated, such as a hammer union. Alternatively, a swivel fitting can be installed in one or both hose attachments. To assist the user, each length of hose has a longitudinal lay line of a different color than the hose cover. By line of sight down the length of the hose, this lay line should remain in view without forming a helical path after the hose is installed. This should be used as a guide in making certain the hose is installed without twisting.

## **A.6 Damage to the outer cover of the hose**

Rotary hoses should be installed to provide adequate clearance between potential interferences. In some cases, due to high winds or offshore rig motion, hoses may come in contact with interferences in the derrick. When this occurs, hoses should be inspected as soon as practicable for any damage to the outer cover. If the cover is damaged to the extent that the reinforcement materials of the hose are exposed to the elements, repairs should be carried out to the damaged area(s) to protect the reinforcing materials as soon as possible. This can be performed with epoxy or polyurethane resins, or other materials specified and approved by the hose manufacturer. If this is not done, moisture will enter into the reinforcement materials, and there are no existing means available to remove it. As a result, corrosion will occur to the reinforcement materials, which over time, will progress to the point where the strength of the reinforcing materials will be reduced, and the pressure integrity and useful life of the hose will be compromised.

## **A.7 Safety clamps**

The hose manufacturer is required to ensure that safety clamps specifically designed for the hose are available for purchase by the user, and to mark the hose body where such clamps are to be fitted in accordance with the requirements in API Spec 7K. Safety clamps shall be designed to provide one or more attachment points that will allow the user to secure a length of chain or a wire rope sling to the safety clamp. Such attachment points shall incorporate a 28 mm (approximately 1<sup>-1/8</sup> in.) minimum diameter hole for attaching a safety chain or wire rope sling and will be so designed as to allow adequate clearance from the hose. The chain or wire rope sling, and the attachment hardware, such as a shackle or connecting link shall have a minimum breaking strength of 72640 N (16,000 lbs), or a working load limit of 3,000 lbs (9600 N) with a 5 to 1 safety factor for hoses up to 4 in. internal diameter. For hoses with 5 in. and 6 in. internal diameter the minimum breaking strength shall be 145280 N (32,000 lbs), or a working load limit of 27240 N (6,000 lbs) with a 5 to 1 safety factor. The chain or wire rope sling shall be used to handle the ends of the hose, and provide a means of restraining the end of the hose if the end fitting becomes disconnected. The free end of the chain or wire rope sling shall be attached to a secure structure or object that is capable of withstanding the breaking force of the chain or wire rope sling, and shall be of a sufficient length without restricting the movement of the hose. The user shall specify the proper safety clamps as specified above to be provided in the purchase agreement for the hose that is being supplied. The hose manufacturer shall include shipment of the proper safety clamp with each hose supplied, and any pertinent installation instructions. Safety clamps provided by the hose manufacturer shall be installed by the user on all rotary, vibrator, and jumper hoses at the locations marked on the hose body. The user shall verify that the safety clamp provided is of the proper size, and is installed in accordance with the hose manufacturer's instructions as provided.

## **A.8 Vibration and pulsation**

Continuous pressure pulsations and vibration may shorten the useful life of rotary, vibrator, and jumper hoses used in high pressure mud piping systems. Surge chambers or pulsation dampeners of the proper size should be installed in each mud pump discharge line to minimize pulsations and vibration in the high pressure mud piping system and hoses. The precharge pressure for pulsation dampeners should be set at 10% of the maximum pump pressure. The suction piping to the pump should be pressure-charged or operated with a flooded suction to minimize cavitation of the drilling mud in the fluid end of the mud pump that can cause pressure pulsations. Pulsation dampeners designed for the pump suction piping should also be installed to minimize pulsation and cavitation. If the corrective measures specified above have been installed but are ineffective in controlling the pressure pulsations to an acceptable level, the user should consider replacing the hose with one that has a higher Flexible Spec Level (FSL) as specified in clause 9.10.3.2 in API Spec 7K. Generally, unacceptable pressure pulsations are those that exceed 10% of the designated standpipe pressure. The user should also consider the installation of digital (versus analog) pressure monitoring instrumentation, coupled with standpipe pressure data logging instrumentation to allow more accurate detection and recording of unacceptable pressure pulsation in the affected hose assemblies covered by this standard during drilling operations. The user is also cautioned that unacceptable pressure pulsations, combined with high operating pressures and / or temperatures (see clause A.9), and / or high flow rates (see clause A.10) and / or certain types of oil based drilling mud (see clause A.13 below) will most likely have a severe impact on the useful life of the hoses affected. High operating pressures in this regard are considered to be those which exceed 80% of the working pressure of the hose.

## **A.9 Operating temperature**

Hose assembly operating temperatures should not be outside the designated temperature range specified by clause 9.10.3.1 of API Spec 7K. Operating a hose outside its designated temperature range will shorten its useful life. The user shall specify the operating temperature range of the hose in the purchase agreement in accordance with the temperature range selections specified in clause 9.10.3.1 of API Spec 7K when purchasing new hoses. If the anticipated operating temperature is above and/or below any of the temperature ranges specified in clause 9.10.3.1 of API Spec 7K, the user shall consult with the hose manufacturer and reach an agreement on the operating temperature range of the hose to be specified in the purchase agreement.

## **A.10 Flow rates and abrasive media**

Flow rates through the hose assembly should not exceed the maximum flow rate specified by the hose manufacturer. Flow rates exceeding maximum values will shorten the useful life of hoses covered by this standard. In addition, abrasive conditions caused by sand or other solids in the mud can cause the useful life of hoses covered by this standard to be shortened. The maximum flow rate for hoses may vary between different manufacturers for the same size and pressure rating. Because standpipe flow rates are increasing due to more demanding drilling conditions, additional mud pumps are being used to provide these higher flow rates. Therefore, it is important for the user to determine whether larger diameter hoses are required to prevent exceeding maximum flow rates. In addition, the user should require the hose manufacturer to provide the maximum flow rate for each hose delivered under a purchase agreement.

## **A.11 Exposure to pressurized gases**

When a rotary hose is exposed to gases under pressure for a prolonged period of time, gases will permeate through the liner. When this occurs, pressurized gas is trapped outside the liner and is not vented unless the hose is manufactured to meet API Spec 17B. If for any reason the hose is subsequently depressurized, the gas will not permeate back through the liner material at a sufficient rate to prevent collapse of the liner. As such, the following guidelines are provided to the user for certain drilling, completion, and workover operations that will or may expose a rotary hose to pressurized gases.

### **A.11.1 AIR AND GAS DRILLING AND WORKOVER OR COMPLETION OPERATIONS**

Rotary, vibrator, and jumper hoses covered by this recommended practice shall not be used in air or gas drilling operations. In addition, whenever it is intended or likely that the hose will be exposed to well bore effluents during workover or well completion operations the user should consider using hoses made in accordance with API Spec 17B instead of hoses made to meet API Spec 7K.

### **A.11.2 UNDER-BALANCE OPERATIONS**

Under-balance operations (UBO) are defined as performing drilling operations with returns to surface using an equivalent mud weight that is maintained below the open-hole pore pressure. UBO shall not be construed to mean the same thing as air or gas drilling, or workover or well completion operations. Most UBO are designed such that there are safeguards and redundancies provided to prevent the rotary hose from being exposed to well bore influx and/or nitrogen injection operations for a prolonged period of time that could damage the hose. When UBO are designed in this manner, and procedures are carefully followed to prevent prolonged exposure of the hose to pressurized gases, hoses made to API Spec 7K may be used without incident. However, some UBO are designed to allow exposure to either well bore influx and/or nitrogen gas, and the user is cautioned to assess the risks of such exposure based on UBO design and arrangement, and to use hoses made to comply with API Spec 17B when such exposure is intended or likely to occur.

### **A.11.3 INSPECTION OF ROTARY HOSES EXPOSED TO PRESSURIZED GASES**

Rotary hoses that have been exposed to pressurized gases should be inspected to determine whether the integrity of the liner has been breached or has collapsed. This can be accomplished with the use of a fiber-optic borescope to visually examine the inner surface of the hose liner over the full length of the hose. The detection of bulges, blisters, punctures, or any other breach of the liner material shall be cause for rejection of the hose from further service, and should be replaced and disposed of.

## A.12 Working pressure

The working pressure for rotary, vibrator, and jumper mud hoses and cement hoses is published by the hose manufacturer and is specified in API Spec 7K, Table 7 and C.1. The user is responsible to ensure that the working pressure of the hose is not exceeded while in service, including pressure surges and pulsations that occur in the system (See A.8, Vibration and Pulsation).

## A.13 Oil base mud

The use of oil base mud having an excessively high aromatic content will cause the hose inner liner to swell and shorten the useful life of the hose. It is recommended that oil base mud be held to a minimum aniline point of 66°C (150°F).

## A.14 Barge-attended offshore rigs

For mud jumper hoses used between barges and offshore drilling rigs, care must be used so that alignment is maintained between both end connections. It is recommended that swivel joints be used at both ends. Operations in rough weather and high seas that induce bends in the hose that could violate the Minimum Bending Radius of the hose (see Table 7 and C.1 of API Spec 7K), and/or high axial forces on the hose will shorten the useful life of jumper hoses in this application, which may cause a failure while in service.

## A.15 Rotary hose field pressure testing

Field pressure testing of rotary hose, when required for establishing periodic safety levels of continued operation, should be conducted in accordance with the following guidelines:

**A.15.1** Visual inspection should include examination of any external damage to the body, end structure, and couplings. Safety clamps should be checked for proper attachment to the hose, and safety clamp fasteners should be checked for damage, deterioration, and tightness. Safety chain or wire rope slings should be checked for damage or deterioration and that they are properly attached to structure capable of supporting the breaking strength of the safety chain or wire rope sling.

**A.15.2** Hoses should be arranged as straight as possible, and twisting (see clause A.5) shall be avoided.

**A.15.3** Prior to conducting pressure testing, the hose should be suspended in normal unstressed position from standpipe to swivel.

**A.15.4** Rate of pressure rise should not be less than 6.9 MPa (1,000 lb per in.<sup>2</sup>) or greater than 68.9 MPa (10,000 lb per in.<sup>2</sup>) per minute.

**A.15.5** All air in the hose shall be bled off prior to applying test pressure. When possible, water should be used as the test media.

**A.15.6** The duration for holding the maximum test pressure in the hose should not exceed 10 minutes.

**A.15.7** Field test pressure shall not exceed 1.25 times the maximum working pressure of the hose regardless of the test pressure that is specified by the hose manufacturer. Test pressures may also be limited to the maximum working pressure of the valves installed in the mud system that are used to isolate the hose for pressure testing based on the maximum pressure that can be exerted on the valve gates or seats as specified by the valve manufacturer.

**A.15.8** The area adjacent to the hose to be tested shall be cleared of unnecessary personnel. Personnel assigned to conduct testing operations should wear appropriate personnel protective equipment, such as gloves, eye shields or goggles, and be positioned out of harm's way in case there is an uncontrolled release of pressure.

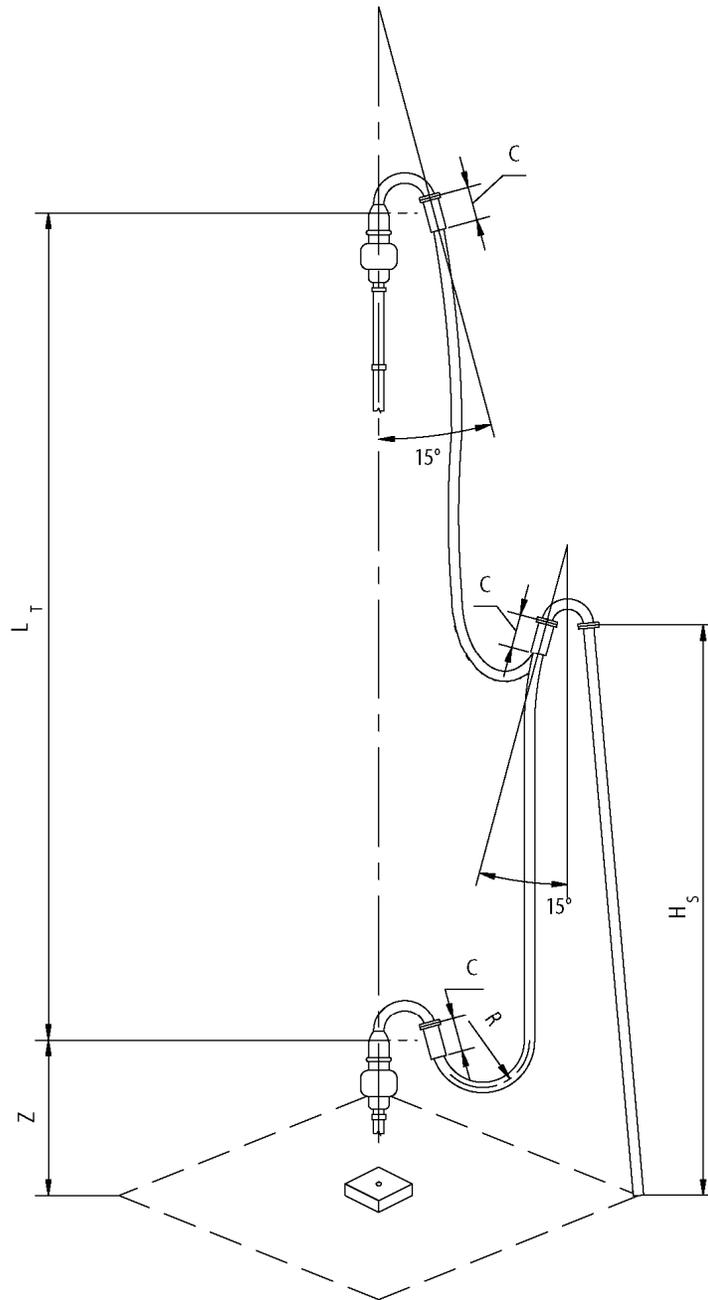
**A.15.9** A means shall be provided to release the pressure contained in the hose under controlled conditions after pressure testing is completed.

**A.15.10** Hoses that are found to be leaking during the course of pressure testing should be removed from service and either repaired or destroyed and disposed of immediately after testing.

## A.16 Hose modifications in the field

Attaching new couplings to used hose body materials is not recommended. Users considering the installation of new hose couplings onto a used hose body for the purpose of continuing to use it in high pressure mud or cement service as defined in API Spec 7K shall be aware that the pressure integrity of such a hose assembly may be compromised. In addition, the user shall be aware

that, regardless of what markings may remain on the hose after re-coupling that would indicate its original compliance with API Spec 7K, its fitness for purpose as originally certified will also most likely be compromised. It is recommended that if used hose is re-coupled by other than the original manufacturer, the original manufacturer's markings should be removed. This includes, but is not necessarily limited to the practice of cutting a rotary hose into shorter lengths for the purpose of fabricating one or more vibrator or jumper hoses.



Key

- C = coupling length, m (ft)
- H<sub>s</sub> = vertical height of standpipe m (ft)
- R = minimum radius of bending of hose, m (ft)
- L<sub>T</sub> = length of hose travel, m (ft)
- Z = height, m (ft), from the top of the derrick floor to the end of hose at the swivel when the swivel is in its lowest drilling position

Figure A.1—Layout for Rotary Hose





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