G2593R9

HANDLING AND RUNNING BEST PRACTICES for NSSMC's High Alloy Materials With VAM® Connection

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General

This document defines the recommended practices applicable to handling, running and storage of NSSMC's High Alloy Materials. These materials used for different types of corrosive applications are split into 3 main groups: R9

- Martensitic: **13Cr, SM13CrS, SM13CrM, SM13CrI, SM17CrS(Martensite plus Ferrite phase)**
- Duplex: **SM22Cr, SM25Cr, SM25CRW**
- Austenitic and Ni based: **SM2535, SM2242, SM2550, SM2050, SMC276**

While the basic recommendations detailed in **ISO10405 "Petroleum and natural gas industries** — Care and use of casing and tubing" remain the foundation for handling, storing and running practices, this document is a compilation of "best in class practices" based on prior experiences in handling storing and running high alloy materials.
The key issues differentiating handling and running of High alloy materials versus Carbon or low alloy steels are:

- Atmospheric corrosion susceptibility of the martensitic materials
- Localized corrosion susceptibility in combined presence of Oxygen and Chlorides
- Specific care to be maintained at all time while handling as well as while in storage to reduce potential spot hardening and imbedded carbon steel contamination since this may affect the corrosion resistance of the material.
- Galling susceptibility of thread and seals while making up and breaking out.

General information for martensitic materials (13Cr, SM13CrS, SM13CrM, SM13CrI, SM17CrS)

13Cr as the forefather of the martensitic stainless steels have been in usage for the last 30 years to address down hole CO_2 corrosion problems. In the last 15 years "modified" were developed, and recently 17Cr has developed, to address specific conditions synthesized as: R9

- Low cost 13Cr: SM13CrI
- High strength sweet service: SM13CrM
- Combined conditions containing CO_2, marginal H_2S & Cl^-: SM13CrS
- More focused to HPHT(high temp. & lower pH in addition to SM13CrS): SM17CrS

Martensitic materials are susceptible to corrosion while in storage in a wet and saline atmosphere. Storage away from the sea shore or indoors in dry conditions is highly recommendable.

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Typically the pipe OD will be un-de-scaled and coated, while the ID will be de-scaled and coated. The remaining OD scale will provide some protection against atmospheric corrosion while in storage, however routine control of coating OD & ID condition will be carried out to ensure the absence of corrosion initiation. The control frequency will be adjusted depending upon the specific storage conditions. Please refer to paragraph I-4-1

General information for Duplex, Austenitic and Ni based materials

Duplex, Austenitic and Ni based materials were developed to address increasing corrosive application severity, that is SCC and pitting corrosion in high temperature chloride & H_2S containing environments.
Because of their high PREN index these materials can be considered to be corrosion resistant to atmospheric conditions.
The applied surface preparation is de-scaled, uncoated OD & ID

The galling susceptibility of these materials is commensurate with their alloying elements (specifically Cr & Mo), and consequently require an even tighter control while running or pulling than the martensitic materials.

I. Transportation, Handling and Storage

General

In order to retain the original material's corrosion resistance properties, adherence to this procedure's requirements and recommendations is highly recommendable.
High alloy materials are manufactured under stringent quality control to obtain the desired corrosion resistance. Improper handling may result in affecting the material performances and by extension their corrosion resistance.
It is then recommendable that operators strictly adhere to the recommendations detailed in this document

1. ***Never use direct-flame heating or welding***
2. ***Do not attempt to straighten a bent pipe. Please consult with an NSSMC rep.***
3. ***Use non marking tong system and lifting equipment inclusive of slips***
4. ***Never hammer the pipe***

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→ Corrosion resistance of high alloy materials can be influenced by produced/injected fluids, packer fluids, completion fluids, acidizing media, as well combination with other material metallurgies. The forms of potential corrosion attacks may be general corrosion, galvanic corrosion, bimetallic corrosion, crevice corrosion, etc. Therefore, it is highly recommendable to investigate the expected sequence of exposures to avoid occurrence of corrosion initiation before running the string.

In case of any doubt, please consult with NSSMC Representatives

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I – 1. Transportation

1) All pipe transportations shall be carried out using the original mill packing system ***to prevent mechanical damage leading to material spot hardening.***

- ***Never use steel band or wire slings directly on these materials***. Instead usage of either textile, or nylon slings, or encapsulated wire slings is recommended.
In situations where local regulations prohibit usage of non metallic slings for offshore handling, usage of lifting frames approved by the local authority (ie Ferguson Seacabs, MSI Rhino lifting U frame) can be considered. Adequate dunnage between these transport frames and the pipes must be used.

- ***Never use metal protectors for these materials*** Instead usage of either plastic or composite or epoxy coated steel protectors is required.

2) Pipes packed in special packaging should be transported on flat bed ensuring good support at all times. The packaging type will be selected based on pipe size, type of material, and customer specific requirements, and may be:

    - ***Bare & Loose pipes with spacer rings***
    - ***Pipes with spacer rings bundle wrapped, and pre-slung.***
    - ***RAP frame system***

- Care shall be exercised to avoid for box ends to hang over.

3) Adequate supervision should be exercised at any point of loading and unloading

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I–2. Handling

1) ***Prevention of Iron Contamination***

Usage of unpadded hooks, chains, rails, unprotected wire slings is prohibited, and contact between pipes and carbon steel shall be avoided whenever possible.

Qualitative judgment needs to be exercised to differentiate what is an acceptable form of contamination from what is not acceptable:

- Superficial C. steel contamination cannot be prevented during transportation and storage because of the immediate vicinity of C steel surfaces.
- Superficial C. Steel contamination has no detrimental effect on the integrity of CRA materials, and this type of contamination can be easily removed with “Scotch Brite” pads, even though this is not a necessity
- Imbedded C. steel contamination into the CRA matrix may become a preferential corrosion initiation point and needs to be cleaned off. For new unused material the only instance where this situation could occur would be in cases of:
    - Handling or transportation incident where the pipe body scraped against a metallic section in which case repairs is advisable (Please refer to Para I-5)
    - Uncontrolled usage of unprotected steel sling, in which case removal of the C steel contamination is advisable. (Please refer to Para I-5)

Pic # 1 Superficial contamination

Pic # 2 Imbedded contamination.

2) ***Prevention of Spot Hardening***

Stress concentration induced by spot hardening has a detrimental influence on the SSCC/SCC resistance of materials. To prevent such damages, it is recommended that materials should be kept in the original packing system until its usage. All pipe movements should be carried out in such a way to avoid damage. Please refer to I-2-3.

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3) ***The following precautions*** should be taken in handling pipe during unloading, loading, and inspection :

1. Before any pipe movement ensure there is no untied protectors.
   In case of handling small size loose R3 tubing, in order to prevent bending, usage of a lift bar is recommendable.
2. Loose pipe handling should be restricted to 3 or 4 pipes maximum at any given time to avoid pipe striking against each others.
   Set on racks protected with hard wood or plastic dunnage. Concerning hard wood quality please refer to I-3-2
3. Do not drop pipe down onto racks while unloading. The pipes should be handled carefully with lifting only one joint/bundle/RAP frame at a time and set on racks with proper supports.
4. Avoid rough handling, which may produce damages.
   In case any transportation damage is detected upon arrival of the pipe cargo, it is recommended to quarantine the suspect material for additional inspection.

I–3. Storage

The following storage and related handling precautions shall be maintained at all times:

1. ***Never unload pipe directly onto ground, steel rail or bar, or concrete floors***.
   To keep moisture and dirt away from pipe, the first tier of pipes should be stored to a ***sufficient height (at least 18 inches) from the ground***.
   In desert conditions this height may be increased to avoid sand drifts to reach the bottom pipe row.
2. ***Wooden stringers or strips fumigated by products containing either chlorine or bromide*** are unsuitable as dunnage, and its usage prohibited.
3. Pipe should rest on skid racks properly spaced to prevent bending of pipe or damages to threads. For R3 length a 4 supports skid rack will be used.
   Dunnage must be placed between each row of pipe to prevent metal to metal contact of pipes and couplings. Dunnage shall be thick enough to allow for lifting slings or padded fork lift arms to fit in.
4. For loose pipes, stagger adjoining pipes by a coupling length to allow each layer to remain parallel.
5. **Block each loose pipe row by nailing a wedge block at both ends of the dunnage spacer.**
6 For RAP frames stacking height will be restricted to 3 frames, and the frame elements staggered for good weight distribution.
7 If open end protectors are used, in order for rain water to drain, the rack supports will be sloped by 2% minimum. The pin end will be located down slope.

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8. The storage recommendations are dependant upon the climate and environmental conditions of the storage yard.
Example of critical conditions requiring corrective action (non exhaustive)

- Air borne Industrial pollutants (cement dust, chemicals)
- Sea spray, or air borne beach sand
- Sand drifts reaching the bottom pipe row.

Under the above conditions either indoor warehousing or the storage location needs to be reconsidered;

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I-4 Storage management

a) The Yard shall be managed on a First In-First Out basis.
b) Whenever possible pipes should be stored as far away as possible from C steel pipe in order ***to prevent air borne iron contamination.***
c) Identification marks shall be kept legible and if required re-applied.

I-4-1Inspection

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The purpose of inspecting stored material is to maintain material traceability, and ensure that protection against corrosion remains efficient

The stored material will be inspected on an established frequency to be defined based on the type of material, and the storage environment. The following table (Figure 1) is an attempt to define the level of corrosion criticality while in storage versus climatic conditions.

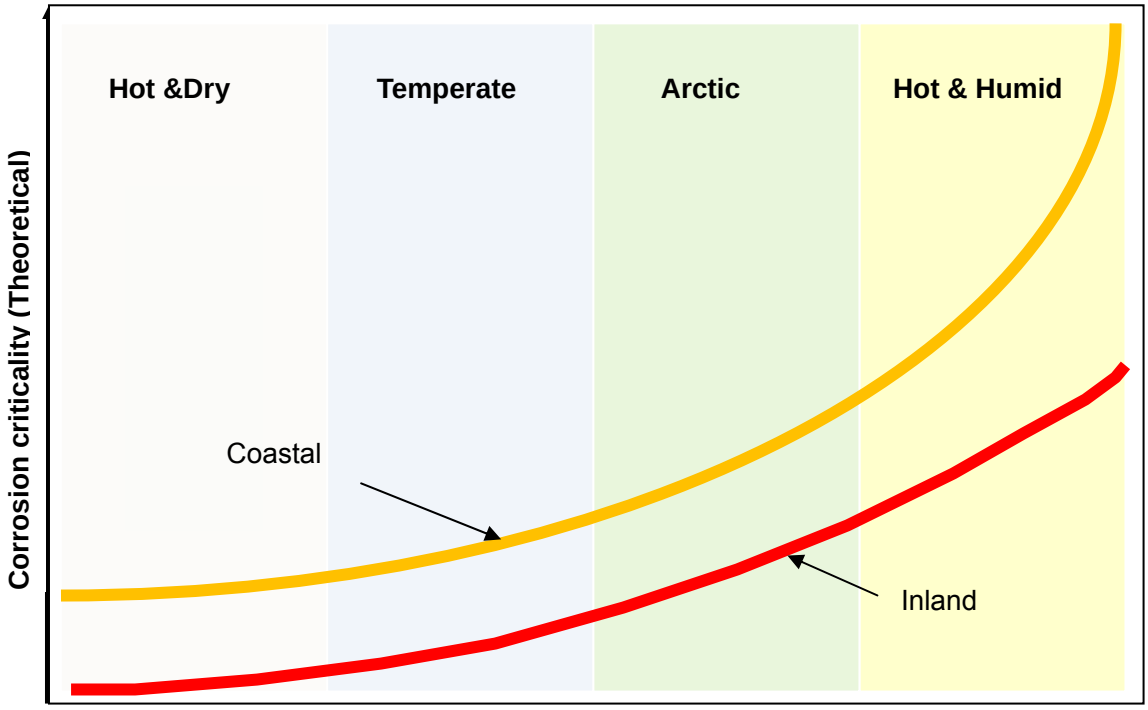

Figure 1: Concept of corrosion criticality versus environment types

The above Figure 1 is strictly qualitative and is essentially based on prior experience. The type of corrosion damage will differ depending upon the environmental conditions, and the following is a broad outline of what to expect:

Hot & Dry: This is the least aggressive environment, however prior experience has indicated that UV rays may rapidly burn the OD coating out and for storage locations close to the sea shore, salt sprays can induce OD pitting on martensitic materials. The location for preferential corrosion initiation will be the top of the pipe OD (12 o'clock – top

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of the pipe).

Temperate: Corrosion initiation does relate to rain water, and the site for preferential attack will be the interphase between pipe body and dunnage/rack (5 & 7 o'clock).

Arctic: Corrosion initiation does relate to sequence of freezing and thawing and corrosion can be exacerbated by the thin film phenomenon specifically for storage locations close to the sea shore. The site for preferential attack will be the interphase between pipe body and dunnage/rack (5 & 7 o'clock).

Hot & Humid: This is the most hostile environment for pipe storage and corrosion initiation is random.

The frequency of visual inspection to ensure that material traceability is not jeopardized and the integrity of the material is not affected by corrosion will be fine-tuned depending upon the environmental conditions.
The sampling rate should be dictated using sound engineering judgment, local experience and focused on the most exposed location of the pipe stack and the most expected form of degradation.

Storage being the most critical period of Martensitic material life cycle, specific attention will be given to corrosion initiation of the OD. As long as quality closed end protectors are in usage (avoiding water seepage) inspection of ID and threaded ends can be carried out on a much less frequent cycle than ODs; typically 10% of the protectors (not the same 10% at each inspection cycle) will be removed to verify threaded end and pipe ID condition.

	Hot & dry	**Temperate**	**Arctic**	**Hot & Humid**
Martensitic	6 months	12 months	6 months	6 months
Duplex & Ni based	6 months	12 months	12 months	6 months

Figure 2: Visual inspection frequency

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I-4-2 Reconditioning of unused Martensitic material showing signs of surface coating degradation.

The below pics illustrate the type of OD coating degradation, eventually leading to pitting initiation.

Pic # 3. Surface rust

Pic # 4, Pitting initiation.

Ideally the following sequence of events should be followed, but depending upon the available equipment set up, variations remain acceptable as long as inspection of the remaining wall thickness after removal of the corrosion, as well as recoating of the OD and re-stenciling the pipe identification is carried out.

1. Record all relevant pipe information, and maintain pipe traceability throughout the process
2. Load tubulars from preparation rack onto wire brush machine.
3. Brush the tubular externally to achieve ST 2 (Swedish Standard, ISO 8501-1 1988)
4. Load tubular onto full length inspection unit (EMI or UST).
5. Any indication of localized corrosion will be ground smooth until complete visual removal of the defect. The repaired pipe will then be re inspected through the full length inspection unit to ensure that the remaining wall is within specification. If this condition is not met the pipe is rejected.
6. Move tubular from inspection unit to OD coating area.
7. Stencil all relevant pipe identifications and if relevant re-colour code pipe body.
8. Apply specified coating
9. Touch up roller marks and allow coating to dry.
10. Install bumper rings on pipe body, if applied upon arrival.
11. Transport tubular from finishing rack to or transport/storage frame.

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I-4-3 Reconditioning of unused rig returned material.

These pipe protectors may have been removed, the threads cleaned, the pipe drifted, and running thread compound applied.
These pipes will undergo the following preparation before being re inventoried:

- Thread protectors and threaded ends will be steam cleaned, and dried.
- For martensitic materials, the pipe ID will be inspected to verify that sufficient anti corrosion coating remains. Any remaining water in the pipe bore will be dried out with compressed air
- For Duplex, austenitic and Ni based materials, the pipe ID will be rinsed with fresh water, dried out with compressed air.
- Threaded ends will be inspected for any mechanical damage
- Storage compound will be applied to the threaded ends and clean & dry protectors bucked on
- Pipe body OD shall be rinsed with fresh water and dried with compressed air
- For martensitic materials, OD scuffing marks where coating has been removed will be touched up with an approved coating/paint.
- The pipe shall be returned to storage

I-4-4 Reconditioning of used rig return material.

It is assumed that the pipe has been run into the well, and eventually pulled.
The details concerning the type of inspection, refurbishment and repairs to be carried out are outside the scope of this document, but 3 issues are critical and need to be adhered to:

1. For ALL high alloy materials, residual completion brines trapped into the pipe bore can induce severe localized corrosion. Consequently flushing with clean non saline water will be carried out as early as possible after pulling.

The pipe bodies and threads will be dried with compressed air, after water flushing.

2. For martensitic material, an approved OD & ID coating needs to be applied as early as possible to avoid flash rusting.

The storage area for used material will be clearly separated from the new unused material storage.

3. Pipe OD & ID shall be dried with compressed air, fresh storage compound applied to the threaded ends, and clean dry protectors bucked on prior to storing the material.

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I-5. Removal of imbedded contamination.

a) Any steel parts which may contact the CRA pipes during transportation, loading & unloading, cleaning, inspection and the removal of rust contamination shall be covered with non-metallic materials to avoid iron contamination.

b) All transportation and handling shall be carried out carefully in order not to induce any further iron contamination or minor surface scratches.

c) Sand or dust deposit on the pipe external surface shall be cleaned by Non saline high pressure water for inspection and removal of rust contamination.

A power grinder shall be used for the removal of imbedded C. Steel contamination.
The abrasive wheel will be No. 36 or finer, and shall not contain Iron or Iron oxides.
The complete removal of the contamination will be visually confirmed
The repair work should be carried out at sufficient distance (min 20 Meters) away from the other pipes to avoid any contaminations on pipes in vicinity.
The operator carrying out this work shall have prior experience in handling specialty materials and will have undergone the specific NSSMC induction course on CRA material inspection practices.

Grinding shall be performed in successive passes in order to avoid excessive material removal. The ground area shall blend uniformly with the surrounding surface as follows:

- Rounded bottom with a large radius
- Smooth transition to the original contour
- No discernible edges present.

Upon completion of a repair, the ground area will be wiped clean with a cleaning solvent (such as Acetone), then visually inspected, to verify the complete removal of contamination.

The remaining wall thickness after completion of repairs shall be measured using a calibrated UWT.
If the remaining wall thickness measured value falls below the specified minimum wall thickness, the part shall be cropped off or the tube shall be rejected.
The remaining pipe OD measured from the deepest point of repair will be measured using a calibrated caliper vernier. If the remaining OD measured value falls below the specified minimum OD, the part shall be cropped off or the tube shall be rejected.

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II. Running of VAM® Connections on NSSMC High Alloy materials

Adherence to the procedures detailed in the below sections is highly recommendable.

The following are critical bullet points:

1) Prior to doping, threads and thread protectors must be absolutely clean, free of grit, nicks, or any other debris or iron powder from magnetic particle inspection
2) Avoid thread damage by keeping protectors in place during all handling operations
3) ***Only Use clean approved thread compound***
   Use soft bristle brush for applying dope. ***Never use any type of metal brush***.
4) Prior to running or pulling out, ***ensure that the elevator/traveling block are correctly aligned with the rotary table***. If substantial misalignment is found, it is advisable to request a rig trim up.
   Alignment is a critical criteria when running high alloy material.
5) Stab vertically.
   Ideally ***make up to hand-tight position by hand or pipe wrench (strap wrench)***
   Alternatively whenever local regulations do not allow for operators presence on the rig floor, rotate counter clock wise with power tong until the pin bumps up, then reverse the make up direction
6) ***Usage of weight compensator is*** advisable for R2/R3 length pipes and ***highly recommendable for multiple lengths (stands).***
7) ***Keep the rotation speed below 5 RPM, and adhere to the recommended torque values.***
8) Verify that the torque gauge has been calibrated recently (< 2 months).
9) It is advisable for critical or new material applications, to contract VAM® Services engineer to help the operators crew in going through the learning curve in handling and running “High value” materials.

II – 1. Preparation before Running

1. Preparation of Equipment and Materials

1) Handling

• The procedures detailed in Paragraphs I-2 (Handling) & I-3 (storage) apply.
Ideally a pick up/lay down machine to bring the joint up to the rig is to be used.
Alternatively the V door, and Samson posts will be padded with non metallic material, to avoid direct metal to metal contact and C. Steel contamination.

2) Elevators and Slips

• ***Slip type elevators are preferred,***
Ideally the elevator and slips should be non marking type. Alternatively standard slips

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and slip type elevator can be used provided they meet the following criteria

- Long slip body to distribute the load of the string over a wide area.
- Fine tooth and curved face slip inserts to reduce sharp tooth penetration.
- Inside diameter of gripping surfaces shall match uniformly the pipe O.D

3) Power Tong and Back-up Tong

• The power tong shall be suitable for the job at hand. Torque capacity should be about 1.5 times the optimum torque of the connection(s) to run; not too much nor too low. ***Never use drill pipe tong or rig tong for make-up or breakout***.

• The Power tong and back up will be equipped with non marking dies.

• The power tong will be equipped with an accurate and recently calibrated torque gauge and a monitoring system having the following functions:

- ***Load cell with electronic strain gauge***
- ***Hydraulic dump valve system activated automatically, when reaching the pre set optimum torque.***
- ***Monitoring system that graphically displays and records the torque – turn***

Note: NSSMC maximum allowable die penetration criteria for CRA material is 0.3mm.

4) *Stabbing Guide*

• ***Stabbing guide shall be used when running or pulling high alloy materials***.

5) *Thread Compound*

• Only Use clean approved thread compound

• Never use any type of compound containing teflon particles

• Never mix the thread compound with any chemical.

6) Cleaning materials

• Clean thread and seal area completely using preferably steam gun or approved solvent.
Do not use oil based solvent such as gasoline or diesel.

• Use rags or bristle brush when cleaning.

• Blow dry the threads and seals insuring that no foreign material remains in the thread root.

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2. Preparation Procedure of Pipes

Details of preparation procedure are as follows :

Unpacking

1. Pipes should be transferred to well site in the original packing system.

Pick up Pipes

1. Use non metallic or nylon encapsulated slings to lift the pipe.
2. Pipe should be put on rack allowing space to permit for easy access for cleaning and inspection
3. Use dunnage for the rack and between each pipe row

Remove Protectors

1. Blow out the inside of pipe from box end to pin end to remove eventual foreign particles.
2. Protectors should be cleaned, dried with compressed air and kept clean for re-use.

Drift

1. Drift from box end to pin end being careful not to damage threads, seal or shoulder. Usage of a Teflon coated drift or non metallic mandrel is mandatory.
2. Drift through the protector in place when open end driftable protectors are used.
3. Keep the drift clean

Measuring Length

1. Measure pipe end to pipe (from coupling end to pin end)
2. Subtract the Make-up loss value indicated in the "VAM® Running Book"

Clean Thread

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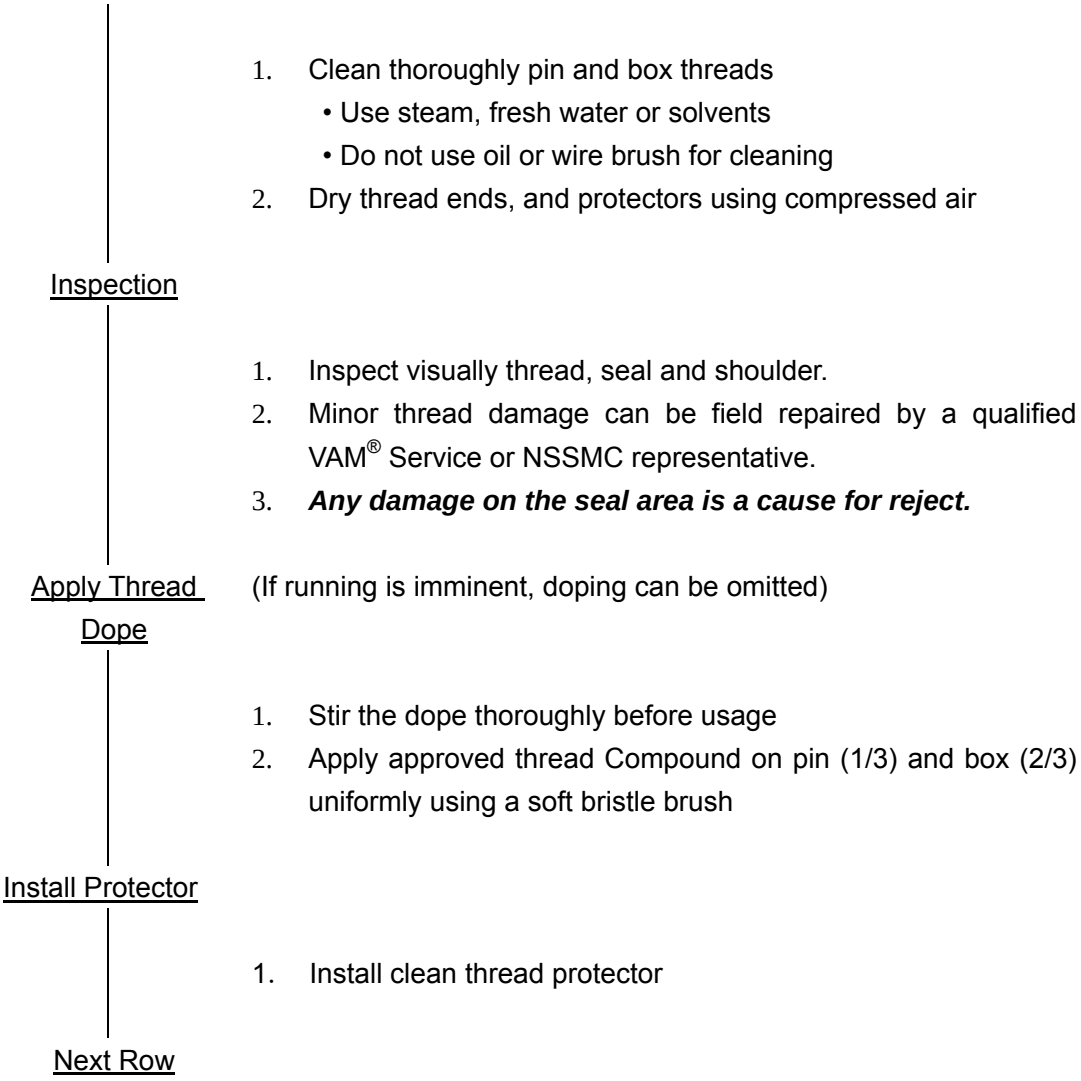

3. Preparation of Accessories

• Since accessories (hangers, safety valves, flow couplings, pup joints, crossovers) lengths are substantially shorter than standard pipe length, as well as often made from different metallurgies, material strengths, the standard practice is to make up these accessories into sub assemblies prior to the completion running, using a quality buck on machine. Usually the made up sub assemblies are pressure tested prior to their release.

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II – 2. Running Procedure

Details of VAM® running procedure for these materials are as follows:

Pick up Joint to V-door

1. Pick up one joint at a time following the procedure in paragraph II-1-1

Pick Joint to Rig Floor

1. Pick up the joint using pick up elevator

Check Thread and Seal

1. Remove the pin protector just before stabbing
2. If undoped, visually check the pin thread and seal for any damage
3. If already doped check the pin thread and seal by running a finger over the surface.
4. If undoped, apply dope.

Stabbing

1. Install stabbing guide before stabbing the pin in.
2. Stab vertically & slowly with stabbers' assistance (if applicable) in maintaining alignment.
3. In conditions where rules and regulations prohibits the presence of a stabber, control and maintenance of pipe alignment throughout stabbing, and thread engagement will be exercised by every possible mean.

Making-up

1. ***Hand Tight (Preferred)***
   Tighten up the joint several turns by hand or strap wrench until difficult to turn
2. ***Whenever hand tight is not possible***
   Rotate counter clock wise with power tong until the pin bumps up, then reverse the make up direction, **at 5 rpm Max or lower if the running conditions are not ideal (misalignment)**.
3. Power Tight
   make up in low gear at ***5 rpm Max,*** and make up to the recommended torque value.

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4. Ensure that pipe is properly aligned during the whole make up phase.
5. Check torque value and torque-turn curve.
   Assemblies showing incorrect make up torque value or abnormal torque-turn pattern must be broken out, both threaded ends cleaned and visually inspected.
6. When using standard dies, check for tong die marks and slip marks on pipe. If the die penetration is too important, take corrective action
7. Refer to "VAM® Running Book" for additional information

Continue Next Joint

II – 3. Breaking-out Procedure

Break-out

1. Set the back-up tong on the lower half of the coupling
2. Break out in low gear for first two turns ***at 2 RPM Max***
3. Ideally, at final breakout stage, switch from power tong to strap wrench to disengage the threads.
   Alternatively, spin out **at Max 5rpm or lower if the running conditions are not ideal (misalignment)**, until the pin bumps into the box.
4. Ensure that pipe is properly aligned during the whole break out phase with stabber's assistance if applicable.
5. Install stabbing guide before lifting up the pin end from the box.
   Lift pipe slowly while avoiding damage to the pin seal area.

Install Thread Protector

1. Install clean thread protector

Lay Down/ Stand Back

1. Stand back pipe on wooden matting

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Cleaning — As soon as practical

1. Rinse pipe internally and externally with fresh water
2. Dry out pipe using compressed air
3. Check thread and pipe body internally and externally
4. Apply thread dope or storage compound on pin and box thread completely

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ⅢGuidelines concerning Brines acceptability for 13CR, 13CRS, 13CRM, 17CRS, Duplex stainless and CRA steel

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The below guidelines are based on laboratory testing excluding O2 contamination or usage of common brine additives such as corrosion inhibitors, biocide, scavengers, etc. Consequently the brine “package” suitability and long term stability needs to be carefully ascertained prior to usage.

	*1 PH	C-steel	13Cr	***13CRS, 13CRM 17CRS***	22Cr(Duplex s.s.)		CR-Ni
		Corrosion *2	Corrosion *3	**SCC *5**	Pitting *4	SCC *5	
NaCl	△	△	○	○	△	○	○
$CaCl_2$	○	△	△	×	×	×	○
$MgCl_2$	×	○	△	×	×	○	○
$ZnCl_2$	×	×	×	×	○	○	○
NaBr	○	○	○	○	△	—	○
$CaBr_2$	○	△	△	○	△	○	○
$MgBr_2$	△	△	△	—	△	—	○
$ZnBr_2$	×	×	×	—	○	○	○

***1) In 60°C** **(1g/m2/h=1.1mm/year)**

0.1MPaCO2

○ : pH≧4

△ : 3<pll<4

× : pH3.≦

***2.3) Autoclave test 150°C、0.4MPaCO_2**

***2)**

○ : C.R.≦1g/m2/h

△ : 1<C.R. ≤10

× : C.R.>10

***3)**

○ : C.R.≦0.1

△ : 0.1<C.R.≦1.0

× : C.R.>1.0

***4) Pitting potential**

○ : Vp≧0.3V

△ : 0<Vp<0.3

× : Vp≦0

***5)**

○ : Crack Free

× : Crack

Brine applications identified with ×are NO GO areas

Brines identified with ○are acceptable for Completion & packer fluid applications

Brines identified with △may be acceptable for short term completion fluid applications.

Addition of corrosion inhibitor, biocide, and oxygen scavenger is recommended but these additives long term stability will be carefully ascertained prior to usage.

Whenever possible an oil base solids free packer

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