Appendix A

Inspection Equipment

The following list provides the calibration frequency of Technical Industries, Inc. Inspection Equipment.

Ultrasonic Gauges

1.	T-Mike	Not to exceed 6 months
2.	Shear Wave / Flaw Detector	Not to exceed 6 months
3.	Depth Gauges	Not to exceed 4 months
4.	U.V. & White Light Meters	Not to exceed 1 year
5.	Amp Meters C.D.	Not to exceed 4 months
6.	Yokes	Not to exceed 4 months
7.	Optiscopes	Not to exceed 4 months
8.	Micrometers	Not to exceed 4 months
9.	Survey Meters	Not to exceed 6 months
10.	VisonArray	Not to exceed 12 months
11.	Thread Gauge	Not to exceed 6 months
12.	Precision Calipers	Not to exceed 4 months
13.	Hardness Testers	Not to exceed 12 months
14.	Length and Diam. Measurements	Not to exceed 6 months
15.	Facility and Portable Lightning	Not to exceed 4 months
16.	Dynamic Insp. Unit Cals.	Not to exceed 4 months (Amps, coil and pulsers) Read out rotation and linear – 6 months.

TABLE OF CONTENTS

REVISION HISTORY

SECTION 21 BLACK LIGHT OF USED CONNECTIONS

SECTION 22 INSPECITON OF STABLIZERS –Pending

Revision History

REV.	Description of change	Effective Date
Rev. A	Initial release with requirements of ISO 9001:2000.	08/03/06
Rev. B	Added revision history table. Changed operations manager to operations superintendent. Added Appendix A.	10/26/06
Rev. C	Added section 14 Portable Field Hardness Testing	07/02/08
Rev. D	Added Section 15, 16, 17, 18	2/28/10
Rev. E	Changed parts of WI Section 11. Revision pertaining to this WI only.	1-03-2012
Rev. F	Added forms for data to Sec. 13 Rev. B 11-5-12 Added Electronic Signature statement to Sec. 1, 1.6.1 Now Rev B 11-26-12.	11-26-12

COPY # *Contact Technical Industries for Registered Copy

SECTION 1 - INSPECTION SUMMARY

1.1 SCOPE

1.1.1 Objective

The specifications and work instructions contained herein are to be used for the inspection of API Oil Country Tubular Goods and related materials by Technical Industries, Inc. This work instruction and inherent standard must not be deviated from without written approval or as stated in Section 1.1.2, 1.1.3, and 1.1.4.
If any customer applies this work instruction and implied Standard, on their material, the customer shall approve this Operating Procedure in writing from that particular customer or that Customer's Representative.

1.1.2 Priority

In any case of conflict between this work instruction and THE CUSTOMER'S SPECIFICATION, the latter will be the controlling document, except as noted in Section 1.1.3.

1.1.3 Regulations

In no case will this work instruction be used or interpreted to transgress any federal, state, or local laws or regulations in effect where it is applied.

1.1.4 Amendments

Amendments or changes, as they apply to this work instruction and included specification, are considered to be improvements. In no case shall amendments be approved which compromise the safety of the persons, equipment, or material involved. In no case shall amendments be approved that sacrifice the quality of inspection performed.

1.1.4.1 General Amendments

General amendments are those amendments made to a work instruction or specification applying to all Customers which have approved this Standard Operating Procedure for use on their material. All general amendments shall be type-written and attached to all registered copies, along with written approval from all Customers or the Customers Representatives and Technical Industries Operations Superintendent or Quality Control Manager. All general amendments shall be dated at the time of writing and also include an effective date. All general amendments shall incorporate a next revision level.

1.1.4.2 Specific Amendments

Specific amendments are those amendments, which apply to a particular Customer or group of Customers. All specific amendments are to be type-written, except as noted below, and attached

to all copies registered to Technical Industries and all copies registered to the Customer, or group of Customers, to which they pertain. Written approval from the particular Customer or group of Customers or the Customers Representative and Technical Industries, Inc., Operations Superintendent or Quality Control Supervisor, must accompany all specific amendments. All specific amendments shall include the Customer name or group of Customer names for which they pertain. All specific amendments shall be dated at the time of writing and also include an effective date.

If specific amendments are required or requested during a job in progress, they may be hand-written at the appropriate place in this specification where they apply. The signature of the Customer or Customer Representative and Technical Industries Operations Superintendent or Quality Control Manager must accompany all hand-written amendments. Hand-written amendments are to be made in blue ink to the "Control Room Copy" where the job is in progress. Hand-written amendments to the "Control Room Copy" must be followed by typewritten amendments to all copies registered to Technical Industries and all copies registered to the Customer or group of they pertain, within (30) days.

1.1.4.3 Temporary Amendments

Temporary Amendments are those amendments, which apply to a specific job or order. All temporary amendments shall be type-written and attached to the final inspection report. Written approval from the Customer or the Customers representative and Technical Industries Operations Superintendent or Quality Control Supervisor, must accompany all temporary amendments. All temporary amendments shall include the Customer name, the date, and the Technical Industries work order number for the job they pertain.

1.1.4.4 Quality Assurance Amendments

This document will be reviewed annually for changes and upgrades.

1.1.5 Revisions.

Any changes to this document must be reviewed by the Customer and Technical Industries Operations Superintendent prior to use.

1.2 INSPECTION FLOW

Technical Industries, Inc. facilities are designed to process material in a specific order. Due to Customer preference or special circumstances, some deviation from this order may be required. Whatever the final order of inspection, the processing or material through-put rate must be independent for each phase of the inspection process. Each inspection process must stand alone and the time required for its application must not be impacted by pressure from other inspection processes or personnel.

1.2.1 EMI Units (Tubing & Casing)
(Tubing 2 1/16" to 5 1/2")
(Casing 4 1/2" to 10 3/4")
Includes inspection sequence only
(SEA is performed using either wet or dry magnetic particle.)

Full length drift
Visual inspection (includes 24” area I.D. and O.D., and threads, if applicable)
A.C. yoke (transverse of upset material)
Circular field inspection
Longitudinal field inspection
Grade verification (EMI UNIT)
Longitudinal inspection (EMI UNIT)
Gamma backscatter inspection (EMI UNIT)
Transverse inspection (EMI UNIT)
Demagnetization (EMI UNIT)
Prove-up inspection

1.2.2 Ultrasonic Unit ET-SERIES (2 1/16" to 26")
Includes inspection sequence only
(SEA is performed using either wet or dry magnetic particle. The SEA area is also designed to accommodate fluorescent liquid-penetrate inspection for non-ferrous material.)

A. Full length drift
B. Visual inspection (Includes 24" area I.D. and O.D., and threads, if applicable)
C. A.C. yoke (Transverse of upset material)
D. Circular field inspection
E. Longitudinal field inspection
F. Demagnetization (End area station)
G. Full length UT inspection (UT Unit)
H. Prove-up inspection

1.3 INSPECTION PERSONNEL

Employee Certification at Technical Industries
(For more information, refer to Qualifications and industries, training program for certification of employees)

1.3.1.1 Quality Control (EMI Shed)

A. Equivalent of ASNT level III M.T.
B. Equivalent of ASNT level II U.T.
C. Equivalent of ASNT level II P.T.

1.3.1.2 Quality Control (UT Shed)

A. Equivalent of ASNT level III U.T.
B. Equivalent of ASNT level II M.T.
C. Equivalent of ASNT level II P.T.

1.3.1.3 Unit Operator & Prove-up (UT & EMI)

A. Equivalent of ASNT level II M.T.
B. Equivalent of ASNT level II U.T.

1.3.1.4 End Area (UT & EMI)

A. Equivalent of ASNT level II M.T.
B. Equivalent of ASNT level I U.T.

1.4 INSPECTION EQUIPMENT

1.4.1 Equipment Calibration

All equipment at Technical Industries, Inc. requiring calibration is governed by the Quality Management System procedure for Calibration. A log of applicable equipment with calibration dates is readily available to the customer on the Technical Industries, Inc. web-site.
(For more information on Equipment Calibration See Appendix A on page 76)

1.4.2 Document List

The following is a list of the items necessary for proper inspection, prove-up, and traceability of tubulars and related materials. The items listed for each area shall be readily available to the personnel working in that area.

1.4.2.1 Control Rooms (EMI & UT Unit

A. Technical Industries, S.O.P. *
B. Customer Specification *
C. API Specification RP 5A5 *
D. API Specification STD 5B *
E. API Specification RP 5B1 *
F. API Specification SPEC 5CT *
G. API Specification SPEC 5L *
H. API Specification BUL 5T1 *
I. API Specification RP 2X *
J. ASTM Standard E709 *
K. ASTM Standard E570 *

L. ASTM Standard E587 *
M. ASTM Standard E164 *

All reference documents must be of the latest publication.

1.4.2.2 Prove-up Area (EMI & UT)

A. Shearwave Instrument
B. Thickness Gauge
C. AC Yoke
D. Depth Gauge
E. Optiscope
F. Spot Light
G. Calibration Standard (Ring & Step)
H. Probe Grinder
I. Disk Grinder
J Buffer
K. Round File
L. Tubular Data Card
M. Tally Tape
N. Metal Marker
O. Erasable Felt Tip Marker (DAC Curve)
P. Blue Ink Pen

1.4.2.3 End Area (Wet & Dry Magnetic Particle)

A. Penetra-meter
B. Gauss Meter
C. Thickness Gauge
D. Depth Gauge
E. Spot Light
F. Calibration Standard (Step Block)
G. Steel Tape Measure
H. Thread Ruler
I. AC Yoke
J. Micrometer
K. Tubular Data Card
L. Files (Knife, 3-Corner, and Round)
M. Probe Grinder
N. Disk Grinder
O. Buffer
P. Metal Marker
Q. Hand Magnifying Mirror
R. Blue Ink Pen
S. Black Light *

T. U.V. Meter *
U. 100 M.L. Centrifuge *

* For use with wet mag. only

1.4.2.4 Cleaning Area

A. Micrometer (Drift Mandrel)
B. Penetrameter
C. Gauss Meter

1.5 MATERIAL IDENTIFICATION

1.5.1 Identification Number

Each piece of material to be inspected shall be assigned an identification number which shall be unique to the individual piece. If identification numbers were previously assigned and applied, these numbers should be used to ensure proper traceability. If material is received with no identification numbers, identification numbers must be assigned in accordance with the Customer specifications.

1.5.2 Inspection Identification Markings

The following identification markings shall be applied approximately ten feet from the mill end of the pipe. (The preferred method of application is with white spray paint/ink or roller using a one inch stencil.)

A. Inspection company name and unit number
B. Type of inspection
C. Inspection company job number
D. Customer Name
E. Customer Purchase Order or Job number
F. Drift diameter (also note special or API)
G. Size
H. Weight
I. Grade
J. Type of connection
K. Manufacturer
L. Date

Example:

T.I. LOG IV SEA WO/00000

CUSTOMER P.O. 000000
9-5/8" 53.50# P-110 LT&C
USS 7/1/92 UNIT 000
SPECIAL FLD 8.500

1.5.3 Defect Markings

In addition to the identification listed in Section 1.5.2, the following identification markings shall be applied to each piece of rejected material, approximately six feet from the mill end. (The preferred method of application is by printing on the product with a white or yellow metal marker.)

A. Defect description
B. Defect depth and remaining wall (if applicable)
C. Location of defect from mill end
D. Initials of the inspector

1.5.4 Sorting of Materials

All pieces classified as containing rejected defects are to be immediately identified with the appropriate markings and, as soon as practical, physically segregated from non-rejected materials.

1.5.5 Color Coding

The pipe shall be color-coded as specified by the Customer, Specifications, or according to API specifications.

1.6 REPORTING RESULTS

1.6.1 Written Report

An inspection report shall be submitted to Customer upon completion of the work Specified on each work order. Reports are kept by Technical Industries Inc. for at least seven (5) years, unless specified otherwise by the Customer. The inspection report shall contain the following:

A. Classification: The final classification of all pieces inspected, and the name of the governing specification.
B. Marking: The type, color, and location of the classification markings applied to each piece.
C. Identification: Pipe size, weight, grade, end finish, and wall thickness.
D. Defects: Type, location, and severity of defects.
E. Tally Sheets: A copy of the pipe tally sheets.
F. Date: The date the inspection work was performed.
G. Work Order: The Customer purchase order, work order, or job number·

H. Job Number: Technical Industries, Job Number·
I. Responsibility: The signature of Technical Industries, supervisor responsible for the conduct and quality of the inspection.

1.6.2 Record Keeping

The following information shall be made available to the Customer upon request. All records will be kept by Technical Industries, for a time period covered under the Quality Management System procedure for Control of Records, unless specified otherwise by the Customer.

A. Personnel: The name, job classification, and certification of all inspectors performing inspection pertaining to the Customers material.

B. Standards: The types used and the date and method in which used.

C. Logs Original inspection logs or tapes.

1.6.3 Optional Records

The following information will be made available to the Customer upon request. Request should be made prior to the work being performed.

A. Equipment: The unit model and serial numbers of all used, and type

B. Methods: The basic type of inspection methods used.

C. Photographs: Any unusual damage or defects can be documented with photographs.

1.7 MATERIAL HANDLING

1.7.1 Loading and unloading

All loading and unloading shall be performed in a safe manner. Material must be handled carefully to insure that none of the pieces involved are dented, bent, or damaged by any of these processes. Particular care must be taken to avoid dropping and banging of the material. No material shall fall or be dropped over a vertical distance of more than one pipe diameter or six inches, whichever is less.

Pipe must be insulated from metal pipe racks, or any metal surface. Surfaces of all insulated areas must be kept clean of all debris, especially metallic debris such as iron powder and metal filings. Otherwise, this debris may be transferred to the pipe as it is rolled along the pipe racks.

1.7.2 Rolling

Movement of pipe must be controlled at all times. Avoid hard contact with any type of stops or lifts. Pipe must be rolled along the pipe racks by hand, gently, to minimize pipe-to-pipe impacts. Wrenches, metal pry-bars, and other types of levers must not be used to roll pipe along the pipe racks. Special attention must be given to the pin threads when protectors are not securely in place. Threads shall have protectors in place whenever possible.

1.7.3 Cleaning Machine

Prior to and during the operation of the machine, special attention shall be given cleaning to the following:

A. Care must be taken when loading and unloading to assure that no threads contact the stops or lift arms.

B. Visual inspections shall be made as the pipe travels through the unit to assure there is no metal to metal contact. Special attention shall be given to any area that could cause thread damage.

C. While magnetizing the pipe on the cleaning machine you must be certain there is no contact between the pipe and the central bar conductor or clamp.

1.7.4 Field Conditions

In certain circumstances in the field where these pipe handling guidelines cannot be strictly adhered to, extreme care must be taken to prevent pipe body and connection damage.

Under no circumstance may pipe be dropped without thread protectors installed on both ends of threaded connection. Under no circumstance may pipe be dropped over a vertical distance of more than one (1) pipe diameter or six inches, whichever is less.

1.8 REFERENCE PUBLICATIONS

The following reference documents shall be available on location at all times. The inspectors shall have ample knowledge of the reference documents that pertain to the inspection that they perform.

A. Technical Industries S.O.P. *
B. Customer Specification *
C. API Specification RP 5A5 *
D. API Specification STD 5B *
E. API Specification RP 5B1 *
F. API Specification SPEC 5CT *
G. API Specification SPEC 5L *

H. API Specification BUL 5T1 *
I. API Specification RP 2X *
J. ASTM Standard E709 *
K. ASTM Standard E570 *
L. ASTM Standard E587 *
M. ASTM Standard E164 *

* All reference documents should be of the latest publication.

Revision History

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Revision History	

SECTION 2 - PRE-INSPECTION PROCEDURES

2.1 INITIAL DELIVERY ACCEPTANCE PROCEDURE

Upon delivery of oilfield tubular goods to the receiving inspection rack the following shall be verified against the work order accompanying the pipe.

A. Joint count
B. Size
C. Weight
D. Grade
E. Range
F. Connections
G. Presence of box and pin end protectors
H. Seamless or ERW
I. Manufacturer
J. New or used
K. General pipe condition (See 2.3.1)
L. Previous inspection markings

This information must be completely congruent with the information on the Work Order. In the event of any discrepancy, the tubular goods are not to be accepted for processing until the General Manager has been notified and/or authorized by the Customer, and the General Manager
has authorized the Inspection Manager or his designate to commence processing of the tubular goods.

2.2 INSPECTION PREPARATION (EQUIPMENT)

The availability and proper working order (if applicable) should be verified on all the equipment listed in Section 1.4.2 of this document. All inspection equipment used, which requires calibration at regular intervals, must be verified to be within the proper calibration dates. (See Section 1.4.1 Equipment Calibration)

2.2.1 Electronics

All electronic equipment will be energized to insure a proper warm up time has occurred prior to the beginning of any calibration or inspection procedures. Proper warm up time must be a minimum of thirty (30) minutes. This is inclusive of, but not limited to, Electromagnetic Inspection Unit electronics, Ultrasonic Inspection Unit electronics, ultrasonic gauges, longitudinal magnetization coils and supplies, and capacitive discharge magnetization units.

2.2.2 Mechanical

Mechanical gauges (i.e., micrometers or calipers, depth gauges, metal rulers, and drift mandrels) must be exposed to the same operating temperature, thirty (30) minutes prior to their

use, to enable them to stabilize their temperature to the prevailing ambient or operating temperature.

2.3 INSPECTION PREPARATION (MATERIAL)

2.3.1 Visual

Pipe or related material must be reasonably clean for inspection purposes. The pipe or related material must be visually inspected for excessive amounts of grease, oil, rust or mill coating. It must be verified that all protectors are in place (if applicable) and also noted if there is any signs of handling damage, such as excessive damage to protectors, gouges, dents, etc. Any of these items listed or any other that is unusual or out of the ordinary shall be brought to the attention of the Customer or Customer representative prior to inspection.

2.3.2 Thread Protectors

VARSOL IS FLAMABLE!!
Do not smoke in areas where Varsol is in use! Use extreme caution when operating electrical equipment in areas where Varsol is in use! Make sure that there is adequate ventilation in areas where Varsol is in use!

VARSOL IS CAUSTIC!!
Prolonged exposure of the skin to Varsol can result in serious burns! Minimize exposure of the skin by wearing rubber gloves and/or by working quickly and intelligently! Minimize exposure of the eyes to Varsol by wearing goggles or safety glasses and/or by working safely and intelligently! Immediately report accidental burns to the Inspection Manager on site.

Pipe is to be processed in a single layer format. Use extreme care while handling pipe with thread protectors removed.

2.3.2.1 Removal of Thread Protector

Thread protectors are to be removed by hand, when possible, or with appropriate strap wrenches, mechanical wrenches, or other devises, such as a special Hydril tool. **Extreme care must be taken to prevent damage to both ends of threaded connections while removing thread protectors**.

Missing, cross-threaded, and/or stuck protectors must be noted and recorded by the Inspection Manager or his designate and reported in the final inspection report. This report must include exactly what attempts were made and the results of the inspection.

SPECIAL ATTENTION MUST BE GIVEN TO THE REMOVAL OF THE BOX END PROTECTORS, ESPECIALLY ON PREMIUM CONNECTIONS, AS TO INSURE THAT NO DAMAGE IS CAUSED TO THE SEAL AREA.

2.3.2.2 Handling

Thread protectors can have sharp edges, metal splinters, and burrs. Gloves and/or extreme care shall be used while handling thread protectors. After removal, thread protectors shall be stacked off the ground. Protectors shall be stacked neatly, away from walking areas. (Protectors are easier to clean if they can be presoaked, in Varsol.)

2.3.2.3 Cleaning

With a brush and Varsol, thoroughly clean the thread protectors. Remove all thread compound, storage compound, grease, oil, dirt and debris from the threaded areas of the thread protectors.

While cleaning, visually inspect the thread protectors for damaged thread protector housings and/or threads. Visually examine the thread protector threads for burrs, metal filings and corrosion. Damaged thread protectors shall be set aside. The Inspection Manager or his designate must re-inspect and visually examine these thread protectors to determine which ones are to be accepted and which ones are to be rejected. The Inspection Manager or his designate must report rejected thread protectors in the final inspection report.

2.3.2.4 Storage

After the thread protectors are thoroughly cleaned, stack them off the ground in a clean area where they will not be exposed to dirt, magnetic particles, or other debris. Protectors shall be stacked neatly, away from walking areas. Thread Protectors must be completely dry before reinstalling.

2.3.3 End Area

VARSOL IS FLAMMABLE!!
Do not smoke in areas where Varsol is in use! Use extreme caution when operating electrical equipment in areas where varsol is in use! Make sure that there is adequate ventilation in areas where varsol is in use!

VARSOL IS CAUSTIC!!
Prolonged exposure of the skin to varsol can result in serious burns! Minimize exposure of the skin by wearing rubber gloves and/or by working quickly and intelligently! Minimize exposure of the eyes to varsol by wearing goggles or safety glasses and/or by working safely and intelligently! Immediately report accidental burns to the Inspection Manager on site.

WEAR RESPIRATORS WHILE WORKING WITH DRY, POWDERED CLAY *to prevent respiratory aggravation and/or possible respiratory infection!*

All cleaning must be done with the pipe in a single layer format. Use extreme care while handling pipe with protectors removed.

2.3.3.1 Cleaning
Surface preparation of the material, prior to inspection, is critically important. All material must be thoroughly cleaned in the area where inspection is conducted.

The following is a general cleaning procedure for all material. For further cleaning procedures see the Preparation of Material section for the specified inspection being performed.

Dislodge all foreign material from the I.D. surfaces, using high pressure air. Before applying high pressure air, make sure the area is clear of personnel, equipment, or materials which could become contaminated with debris. Apply high pressure air from the box end (if applicable) of the pipe, so that foreign material is not collected in the box end threads.

Using Varsol and/or dry, powdered clay and hand-held bristle brushes and/or power-assisted wire flue brushes, thoroughly clean the end area of the pipe. For EMI inspection the pipe must be cleaned a minimum distance of twenty-four (24) inches from the end of the pipe. For UT inspection the pipe must be cleaned a minimum distance of fifteen (15) inches beyond the pipe, the threads, upset, whichever is farthest.

After the I.D. and O.D. surfaces of the end areas are clean, dislodge all foreign material from the I.D. and O.D. surfaces of the end areas, using high pressure air. Before applying high pressure air, make sure the area is clear of personnel, equipment, or materials which could become contaminated with debris. Apply high pressure air from the box end (if applicable) of the pipe, so that foreign material is completely removed from the box end threads.

In circumstances or field situations where this sequence cannot be followed or where high pressure air is not available, hand clean and/or wipe with bristle brushes and/or shop towels until the I.D. and O.D. surfaces and the threads are dry and free of all foreign material. If the customer specifies that all foreign material be blown from the pipe, the Inspection Manager or designate must make available a hand-held Power Blower.

2.3.3.2 Handling

After the material is clean, special care must be taken to prevent contamination to the cleaned area, which could hinder inspection. Use extreme care while handling pipe with exposed threads. Movement of the pipe must be controlled at all times.

2.3.3.3 Storage

Threads must not be left exposed while the facility and/or crew are not in operation. This does not include temporary shut-downs. A temporary shut-down is anything which could cause a break in the operations for less than two (2) hours. Such as; unit or equipment malfunctions, power failure, crew change, lunch, breaks, etc. During a temporary shut-down, good judgment must be exercised, to prevent exposed threads from becoming damaged and/or contaminated due to weather conditions.

When the facility and/or crew is closing operations for a longer period of time than a temporary shut-down, exposed threads must be protected. Protect exposed threads with a plastic covering or thread compound. Light weight oil may also be used. If the pipe may be exposed to bad weather conditions and/or left unattended in excess of twenty-four (24) hours, the threads must be completely protected.

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Revision History	--

SECTION 3 - DRIFT TESTING

3.1 MATERIAL

The drift mandrel shall be made from steel, plastic or hardwood. For CRA material the drift mandrel must be made from plastic (such as Teflon, Nylon, PVC, etc.) or hardwood.

3.2 SHAPE

The drift mandrel shall be cylindrical in shape and may have attachments on one or both ends. Disk and barbell-shaped mandrels shall not be used. The leading edge of the drift shall be tapered or rounded to provide easy entry into the pipe.

3.3 DIMENSIONS

The drift mandrel diameter and length shall be in accordance with Section 6 of API Specification 5CT unless otherwise stated by the Customer or Customer Representative. The drift mandrel and measuring device must be exposed to the same operating temperature, thirty (30) minutes prior to their use, to enable them to stabilize their temperature to the prevailing ambient or operating temperature.

3.3.1 MEASURING DEVICE

The measuring device used for the outside diameter shall be a micrometer, dial gauge, or vernier caliper capable of measuring the drift mandrel with an accuracy of 0.001 inch. The measuring device used for measuring the length of the drift mandrel shall be a steel tape or rule with 1/16 inch increments. The measuring device shall be calibrated on a schedule not to exceed four months.

3.3.2 MEASUREMENT READINGS

The outside diameter of the drift mandrel shall be measured at both ends and the midpoint. A minimum be of two (2) measurements, 90° apart, shall be taken at these three (3) points. The length of the drift mandrel shall be measured from behind both of the tapered or rounded ends. The drift mandrel must be measured at the beginning and end of each workday, and after each one hundred (100) lengths inspected.

3.3.3 TOLERANCE

The tolerance allowed on the API specified drift diameter shall be +0.005 inch, -0.000 inch. The tolerance allowed on the length of the drift mandrel shall be ± 1/16 inch. If a drift mandrel is found to be out of tolerance, all pieces tested since the last good check shall be re-drifted. This is control of non-conforming material.

3.4 PIPE CONDITION

Prior to any drift testing, the pipe must be cleaned according to Section 2.3.3.1 of this specification. The pipe shall be properly supported to prevent any sagging.

3.5 OPERATION

The drift mandrel shall be inserted and removed carefully to prevent the drift, threads, or seal areas from being scratched or damaged in any way. The drift mandrel shall pass freely through each length of pipe. The maximum allowable force to be exerted on the drift mandrel shall not exceed the total weight of the mandrel. If the drift does not pass through the entire length of pipe, remove and clean both the mandrel and the pipe. Check the pipe for sagging and provide additional support, if necessary. Attempt the drift test again from the other end of the pipe. **If the drift mandrel does not pass through the entire length on the second attempt, the length** is considered a reject and must be marked immediately as a "No Drift plus a red band".

REVISION HISTORY

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Revision History	--

Section 4. Visual and Dimensional Inspection

4.1 Scope

This work instructions sets forth the requirements or descriptions for visible lighting, mechanical equipment and the procedures for visual and visual thread inspection of OCTG

4.2 Referenced Documents

API RP 5A5 Field Inspection of New Casing, Tubing and Plain End Drill Pipe
API 5B Specification for Threading, Gaging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads
API RP5B1 Recommend Practice for Gauging and Inspection of Casing, Tubing, and Line Pipe Threads
API 5CT Specification for Casing and Tubing
Technical Industries Qualification and Training Manual
Technical Industries Equipment Calibration Program

4.3 Personnel Qualification

All personnel performing work within this work instruction shall have a qualification level that has satisfied the requirements of Technical Industries Qualification and Training Manual. All trainees will be supervised by a Level II.

All personnel shall have passed the Visual Acuity and Color Contrast eye examination of the program.

4.4 Equipment

4.4.1 Lighting for Inspection

4.4.1.1 Adequate illumination must be provided in the area of visual inspection. Direct daylight conditions do not require additional lighting sources.
Facility and night light levels at the surfaces of materials to be inspected must be at a minimum of 50 foot candles. Proper illumination shall be checked every 4 months and recorded in a log book. The date, name of person checking and the reading shall be recorded.
Night lighting with portable equipment shall have the same requirement, 50 foot candle, and shall be verified prior to job start.
Light meters used to verify illumination shall be calibrated according to the TI Equipment Calibration Program and shall be for 1 year maximum.

4.4.1.2 Mirrors used for internal surface illumination shall be non-tinted and have a non-distorted image. The reflecting surface shall be flat and clean.

4.4.1.3 Spotlights used for inside surface illumination shall be capable of producing 100 foot candles at the maximum inspection surface. This demonstrated capability shall be documented in accordance with the TI program for calibration.

4.4.1.4 Borescopes or internal cameras shall have the ability to illuminate and be able to read the date on a coin or Jaeger J-4 letters placed within 4 inches of the objective lens. This ability must be documented prior to usage.

4.4.2 Gauges

4.4.2.1 Calipers (micrometer, vernier & dial caliper) shall be calibrated using the guidelines of TI Calibration Program ever 4 months. The calibration shall be recorded in the log book and be affixed to the instrument in some form. Instruments shall be verified as accurate through-out the operating range of the instrument. They shall be kept in good condition and not exhibit any sticking or hesitation of movement during its use.

4.4.2.2 Length and diameter measuring devices (steel rules, steel length or diameter tapes and any other non-adjustable measuring devices) shall be verified to have its markings legible and its fixed reference points in good condition. The verification should be documented on a fixed time interval.

4.4.2.2 Depth Gauges shall be verified to be accurate through-out the operating range of its usage. This verification shall be documented and recorded on a log book and affixed to the gauge. This should be verified every 4 months and shall have accuracy within .001” of actual depth of a reference standard.
The gauge shall always be zeroed on a flat surface prior to use.
The base anvil shall always be in a locked position and perpendicular to the travel of depth shaft.

4.5 Visual Examinations

4.5.1 Full Length Visual Inspection is a visual inspection of the outside and inside surfaces excluding threads to detect apparent visual imperfections such as pits, gouges, dents, cuts, straightness and other visually detected imperfections. Each length is rolled and examined for the entire surface area.

4.5.2 External surface examinations shall be done as follows:

- Position the joint to view appx. 1/3 of the surface area at a time.
- Examine each pipe surface by walking the length of each pipe from one end to the other. The number of lengths examined will depend on the diameter.
- Each indication found will be marked for evaluation to the material specification.
- After the top 1/3 of the surface area has been examined roll the material by 1/3 turn and repeat the above. Repeat this process until all 360° of the surface area has been examined 100%.

4.5.3 Internal surface examinations shall cover the entire 360° area 100%.

- Position the joint so that the inside surface can be adequately examined by the inspector using the light source.
- Use a light source that meets the requirements of this work instruction.
- The best quality internal surface inspections are accomplished with a borescope or camera.
- Mark all imperfections located on the ID, on the OD in as close approximation to the location as possible.
- Imperfections located shall be evaluated with whatever inspection tool that gives the best determination of actual size and detriment.

4.5.4 Outside diameter verification may be requested by the customer to assure compliance with the relevant material specification. This may be accomplished by the use of the following equipment.

- Snap gauges to determine min. and max. diameter.
- Micrometers or mechanical calipers will be used to measure actual diameter. The gauge must be able to read in thousands of an inch.
- Diameter tapes shall be used to measure average diameter.

4.5.5 Straightness is a visual examination to determine if material is bowed or has hooked ends.

- Pipe to be examined shall be placed on rack that will allow full rotation of the joint several times in this examination.
- Locate area of deviation by observation and position it in a plane that is best for evaluation.
- Using a straightedge of 5’ length min. or a taut string (wire) lay it across the plane of the material and measure the deviation with a steel scale or rule.
- Measurement for bowed pipe shall be from end to end.
- Measurement for hooked ends shall be from the tube toward the suspected deviation.
- Deviation shall be evaluated by the relevant material specification.

4.5.6 Visual Thread inspections are performed on threaded pipe ends and include the coupling if attached. The method is used to locate thread imperfections without using magnetic particle inspection or thread gauges other than a profile gauge.

4.5.6.1 Equipment needed to perform this inspection is:

- Steel scale for determining the Lc area on pins and the Perfect Thread Length [1/2NL-(J+1P)] on the internal threads.
- Mirror for inspection of load flanks and roots of internal threads.
- Bright light for inspection of the internal threads.
- Profile gauge
- Flexible steel measuring tape for measuring circumference for non-full crested or black crested thread length.

4.5.6.2 All thread protectors shall be removed, cleaned and stacked away from the inspection area. Pipe shall not be moved without protectors applied to the threaded connections.

4.5.6.3 All threads will be cleaned thoroughly ensuring that no thread compound, dirt or cleaning material remains on the threads.

4.5.6.4 Determine the Lc length of the pin and record the dimension.

4.5.6.5 Determine the Perfect Thread Length (PTL) and record.

4.5.6.6 Slowly roll the individual lengths at least one full revolution while examining the threads.

4.5.6.7 Inspect for imperfections on the face, chamfer, Lc area, Non-Lc area of the external threads. Apply the thread profile gauge to detect machining errors.

4.5.6.8 On Buttress threads the triangle stamp location shall be verified on the field end. The stamp shall be present and at a distance of A1±1/32”.

4.5.6.9 For internal threads inspect for imperfections in the counter bore, PTL, and threaded area beyond the PTL. Seal ring grooves shall be inspected for fins, wickers, and ribbons on each side of the groove. The thread profile shall be applied to the threads to detect machining errors. Care should be taken not to damage the coupling coating during examinations.

4.5.6.10 Coupling Make up position shall be checked on Buttress threads by observation of the end of the coupling in reference to the triangle stamp

location. The coupling end should be located between the base and the apex of the triangle. If it does not verify make up location by measuring distance N-A4, +.200"/-.375".

4.5.6.11 For round thread coupling make up position shall be measured and comply with dimension N-L4 ± .250".

4.5.6.12 Imperfection categories can be found in API 5A5, 5B and 5B1 and related dimensional evaluation categories.

4.5.7 Visual of Pipe Ends

- Each length is visually inspected on the outside surfaced for a distance no less than 18" from the end of the pipe for detection of visible imperfections.
- Upset products shall be inspected for the distance of the upset including run out interval.
- All imperfections detected shall be marked for evaluation.

4.6 Classification of Imperfections.

All imperfections detected and marked for evaluation shall have their disposition determined by the relevant specification.

- Pipe Body imperfections will be evaluated by the current API specification 5CT, 5L, 5D, Spec 7, RP7G or customer specification.
- Thread imperfections shall be evaluated based on API 5B or customer specification.

4.7 Reporting and Marking

All precision tools used for location and evaluation of material shall be listed with current calibration information.

All material that is acceptable shall have a white band applied. All other material if reject shall be painted red and any repairable shall be painted yellow. Customer specification can be used in place of this arrangement.

All material accepted shall be listed with serial number referenced. All material not acceptable shall be listed by serial number with the cause of non-acceptance and the location of the non-acceptable area.

A summary report (F.8.2.4-8) shall be completed stating:

- customer,
- services rendered, and date of service
- specification for classification used,
- total acceptable pieces and footage,
- total non-acceptable, reason for non-acceptance and footage (F.8.2.4-7)
- total repairable, defect location and footage (F.8.2.4-7)
- Inspector name
- Any comments to note on the job.

REVISION HISTORY

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Complete Revision History	--

SECTION 5 - END AREA INSPECTION (WET AND DRY)

5.1 CIRCUMFERENTIAL MAGNETIZATION

The pipe is to be positioned over the central bar conductor. A magnetic field sensitivity indicator is to be placed on the pipe O.D. surface with one of the artificial flaws perpendicular to the longitudinal axis of the pipe. After applying a thin layer of dry magnetic powder to the brass lid, close and verify that the clamp is making intimate contact with the central bar conductor. Verify that the capacitor bank is fully charged. If so, discharge the bank into the central bar conductor. Verify the presence of a proper representation on the field indicator. Place a magnetometer within the proper distance from the pipe end and check for correct magnetic field orientation. In the case that residual longitudinal field still remains, repeat the circumferential magnetization until proper criteria is met.

5.2 INSPECTION USING CIRCUMFERENTIAL FIELD

5.2.1 Preparation of equipment

(Step 5.2.1 applies to the wet fluorescent method only. If the wet fluorescent method is being used, proceed with steps A. through H. If the dry visible method is being used, proceed to 6.2.2)

A. The black light shall be checked at the beginning of the job and after every 8 hours of operation. Use a calibrated light meter sensitive to ultraviolet light centered on a wave length of 365 nanometers. The light meter shall be no closer to the black light source than the normal inspection distance. Warm the bulb for at least 5 minutes prior to the test. The reading must be at least 1000 microwatts/square centimeter.

B. Fluorescent particles shall be made of magnetic retentive, low coercive force, finely divided ferromagnetic material.

C. If oil is used for the bath, it should be a light, well-refined petroleum distillate of low sulfur content. Do not use diesel or other fluids with natural fluorescence. Varsol, number 1 kerosene, and Isopar-M work well as carriers.
Because of its low natural fluorescence, water is acceptable provided it is treated with a wetting agent.

D. Make sure the bath is agitated frequently or continuously during inspection and before checking. If the bath is pump operated, let the pump motor run for several minutes to uniformly mix particles and liquid.

E. Flow the bath mixture through the hose and nozzle for a few moments to clear hose.

F. Fill a 100 ml centrifuge (an ASTM pear-shaped centrifuge tube with a 1-ml stem [0.05-ml divisions] or equivalent shall be used.) to the 100 ml line with fluid from the inspection bath. Take the 100 ml sample from the hose or nozzle.

G. Allow to settle for approximately 30 min. The volume settling out at the bottom of the tube is indicative of the particle concentration in the bath. The recommended settling volume is from 0.1 to 0.5 ml in a 100 ml bath sample. If the bath concentration is low in particle content, add sufficient amount of particle materials to obtain the recommended reading; if the suspension is high in particle content, add sufficient vehicle to obtain the recommended reading.

H. If the settled particles appear to be loose agglomerates rather than a solid layer, take a second sample. If still agglomerated, the particles may have become magnetized; replace the suspension.

5.2.2 Preparation of Material

5.2.2.1 Verification of Surface Condition

The surface condition is to be verified immediately prior to magnetic particle inspection. The surface shall be free of grease, oil, dirt, loose scale, or any other material that could hinder powder mobility. This verification is to be the responsibility of the person performing the inspection.

5.2.2.2 Verification of Orientation and Strength

The magnetic field orientation and strength, for at least a random sampling of the order to be inspected, shall be verified immediately prior to the application of magnetic particles. This is to be accomplished using an ASME, Section V type magnetic penetrameter or customer approved orientation and strength indicators.

5.2.3 Application of Magnetic Particles

(For specifics on application of magnetic particle, see Section APPLICATION.) Wet and dry XIII SPECIFIC

Apply particles or bath to the OD and ID of the couplings and end areas, including the pin and coupling threads, for a minimum of 36 inches from each end. Slowly rotate the pipe at least one full revolution while examining the pipe surfaces for indications.

5.2.3.1 Dry Magnetic Particle

Dry powders are to be applied in such a manner that a light uniform, dust-like coating settles upon the surface of the test part. The preferred application technique suspends the particles in air in such a manner that they reach the part surface in a uniform cloud with a minimum of force. Care should be taken to "lightly dust" the surface. Excessive amounts of powder can mask indications.

5.2.3.2 Wet Magnetic Particle

The bath shall be applied either by spraying or flowing over the areas to be inspected. Low-velocity flow shall be used to prevent washing away or obliterating fine or weakly held indications.

5.2.4 Prove-up of Indications

Any threaded area producing a relevant powder indication shall be evaluated according to API 5B, Section 2.2 or the appropriate specification for that particular connection. Any area other than threads producing a relevant powder indication shall be further evaluated. All prove-up of indications requiring circumferential magnetization shall be completed before continuing to longitudinal magnetization.

5.3 LONGITUDINAL MAGNETIZATION

The following instruction is for the proper adjustment of longitudinal magnetization coils and supplies for use in end area inspection. This procedure shall only be executed by an individual holding a minimum of a magnetic particle Level II rating.

5.3.1 Dry Magnetic Particle (Coil Setting)

The magnetizing coils are to be located along the joint in an area from the end, approximately equal to the radius of the coil being employed. Using the O.D. level control knob, the current should be advanced until the powder becomes immobile. This is the point where the powder appears to be "standing". Now begin reducing the current until such time as the powder once again becomes mobile. This is the point where the powder appears to "lay down". The procedure for the I.D. is the same except for the use of the I.D. control knob. Being as the I.D. requires a higher current level than the O.D. in this particular set-up, it is recommended that the O.D. current level be set first. This will avoid having to demagnetize in order to set the O.D. current level.

NOTE:
Caution must be used while advancing the current level to avoid over magnetization. This condition will result in an excess of residual magnetism which will refuse to permit powder mobility regardless of the amount the current level is decreased. If this occurs, the pipe must be demagnetized and the procedure repeated.

5.3.2 Wet Magnetic Particle (Coil Setting)

The magnetizing coils are to be located along the joint in an area from the end, approximately equal to the radius of the coil being employed. Place a magnetic penetrameter, or other approved magnetic particle field indicator, on the I.D. surface of the pipe. Advance the current level until the field is strong enough to show a clear indication which is perpendicular to the pipe axis. Advances to the current level should be in increments of approximately ten (10) gauss. Fresh bath should be applied to the magnetic particle field indicator, after each current level advancement.

5.4 INSPECTION USING LONGITUDINAL FIELD

It is assumed in this section that the inspection using circumferential field is to be completed immediately prior to the inspection using longitudinal field. Therefore the equipment and material are also assumed to be in the proper condition for inspection. If for some reason this is not the case, refer to Section 5.2.1 Preparation of Equipment and Section 5.2.2 Preparation of Material before continuing.

5.4.1 Verification of Orientation and Strength

The magnetic field orientation and strength, for at least a random sampling of the order to be inspected, shall be verified immediately prior to the application of magnetic particles. This is to be accomplished by using an ASME, Section V type magnetic penetrameter or customer approved orientation and strength indicators.

5.4.2 Application of Magnetic Particles
(For specifics on application of magnetic particle, see Section APPLICATION wet and dry XIII SPECIFIC)

A. Verify that the magnetizing coil is at the proper O.D. setting. (Only one setting is used with wet magnetic particle inspection.)

B. Locate the magnetizing coil along the joint in an area from the end, approximately equal to the radius of the coil being employed.

C. Apply particles or bath to the surface of the pipe. This includes couplings and pin threads if applicable.

D. Slowly rotate the pipe at least one full revolution while examining the pipe surfaces for indications in the area of the effective field. (This is the area extending on either side of the coil a distance approximately equal to the radius of the coil being used.)

E. Move the coil a distance no greater than the coil diameter and repeat steps C. and D. until a minimum of 36 inches from the end of the pipe has been completed.

F. Repeat B. through E. for the I.D. surface. (The magnetizing coil must be changed to the I.D. setting if dry magnetic particle is being employed.)

5.4.3 Prove-up of Indications

Any threaded area producing a relevant powder indication shall be evaluated according to API 5B, Section 2, 2.2 or the appropriate specification for that particular connection. Any area other than threads producing a relevant powder indication shall be further evaluated. All prove-up of indications requiring the O.D. setting shall be completed before continuing to the I.D. setting.

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A	Initial Release	2006
--	See Table of Contents for Complete Revision History	--

SECTION 6 - POST END AREA INSPECTION (WET AND DRY)

6.1 DEMAGNETIZATION

Demagnetization is required if the SEA is not to be followed by an E.M.I. inspection. Demagnetization is accomplished by the use of the end area coil (D.C. circular coil). The demagnetizing force must be at least as strong as or stronger than the residual field. The coil is set for demagnetization as instructed in the following steps:

A. Adjust the current level control knob that will be used for demagnetization to zero.

B. Locate the magnetizing coil along the joint in an area from the end, approximately equal to the radius of the coil being employed.

C. Reverse the current direction from that which was used to last magnetize the pipe.

D. Place a calibrated magnetometer or other approved field strength indicator, the appropriate distance from the end of the pipe.

CAUTION: The indicator shall never be placed in an area where the field intensity is greater than the range of the indicator. Slowly move the indicator toward the pipe. If the indicator reading reaches 'the end of its scale before touching the pipe, it should be held at that position until noted in step E.

E. Slowly increase the current level until the indicator reading moves toward zero. Continue increasing the current level until the field reverses direction (passes zero) by five (5) to ten (10) gauss. (Make note of setting for the current level knob.)

Note:
If the field intensity was such that the indicator had to be kept at a distance from the pipe, it shall now be moved to the appropriate distance (usually very near or against the pipe) as the field intensity decreases.

F. Slowly decrease the current level until the indicator reading again moves toward zero. If continued decreasing of the current level causes the field to again reverse direction by more than five to ten gauss, step E must be repeated at a higher current level. (Increase the amount the field reverses by five to ten gauss more than the previous increase).

G. Repeat steps E and F until the residual field is less than ten gauss. If step F results in a reading of ten gauss or more in the opposite direction from the original field, you must repeat the procedure starting from step C.

6.2 REMOVAL OF INSPECTION MEDIA

6.2.1 Removal of dry powder

At the conclusion of the end area inspection all foreign material shall be removed from the threads and inside surface of all pipe sections. The pin end threads shall be cleaned by a dry brushing action. All powder and other residue shall be completely out of each joint, by the use of high pressure air. If the pipe is blown out from one direction it should be from box to pin. If the pipe is blown out both directions, the last direction shall be box to pin.

6.2.2 Removal of Wet Particles

Clean all particles from any area that was affected by the bath, by flushing the area with a clear liquid similar to that used for the particle bath. All threaded areas shall be completely dried before the application of a thread compound. If wet magnetic particle inspection is to be followed by full length ultrasonic inspection special attention must be given to the following:

A. If an oil based solution is used for the bath, the pipe shall be completely dried prior to ultrasonic inspection. This is to prevent a coupling loss.

B. The I.D. shall be completely dried. Liquids remaining on the I.D. can dampen signals by preventing a steel to air interface on the I.D. wall surface.

6.3 THREAD COATING AND PROTECTOR REPLACEMENT

6.3.1 Thread Preparation

All foreign material shall be removed from the threaded areas prior to the application of any thread coating. This may be accomplished through the use of either low air pressure or through a brushing action with a stiff nylon brush. Metallic bristle brushes are not to be used on tin-plated threads.

6.3.2 Application of Thread Compound

A clean thread compound, meeting API Bulletin 5A2, shall be evenly applied to the entire threaded region and all sealing surfaces. A visual inspection shall be performed prior to the installation of protectors to insure proper application of thread compound.

6.3.3 Application of Thread Protector

Clean and dry thread protectors shall be reinstalled in a secure manner as soon as possible after inspection operations are completed. The thread protectors shall not have rust on surfaces that directly contact the pipe or coupling threads. Damaged thread protectors shall not be placed back on pipe.

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--	See Table of Contents for Complete Revision History	--

SECTION 7 - END AREA INSPECTION (LIQUID PENETERANT)

7.1 LIQUID PENETRANT INSPECTION (LPI)

This work instruction covers fluorescent, water washable penetrant inspection of the end areas. This procedure is derived primarily from ASTM E-165 with modification for OCTG inspection. Because of the complexity and slow speed of LPI, its use is not recommended when shear wave inspection can be used instead.

7.1.1 MATERIALS

Verify that cleaning developer, solvent and penetrant type is proper for use on the parts to be inspected.

A. The manufacturer's compatibility information for the solvent, penetrant and developer shall indicate that the materials are suitable for use as a system.

B. Nickel base alloys shall be inspected using materials with sulfur contents of less than 0.005 grams per one hundred (100) grams (0.5%). For all other alloys, materials containing not more than 1% sulfur by weight shall be used.

C. Austentic stainless steels, duplex steels and titanium alloys shall be inspected using materials with a halogen content of less than 0.5%. All other Stainless alloys shall be inspected using materials containing not more than 1% halogens by weight.

7.1.2 CALIBRATION

Verify the adequacy of the penetrant materials and of the anticipated procedural steps by testing a cracked test piece. The test piece may be a Liquid Penetrant Comparator as described in Section V, ASME Boiler and Pressure Vessel Code or a quench cracked 3/8 inch thick block of 2024-t3 aluminum alloy plate. The test must be performed at the same temperature as the inspection.

7.1.3 EQUIPMENT AND SETUP

Ensure that adequate facilities are available for cleaning the material, for observing the test in darkness and for post inspection cleaning and handling. Facilities shall completely enclose the ends of the pipe.

Verify that the ultraviolet light source has sufficient intensity. Recheck the light source after every eight (8) hours of operation and whenever it is shut down and restarted. Measure the light intensity with a digital light meter. The meter shall be sensitive to ultraviolet light centered on a wave length of 365 nanometers. With the light at the normal inspection distance from the meter, the intensity shall be at least 1000 microwatts per square centimeter.

If compressed air spraying is used to apply penetrant or developer, the air system shall have adequate filtration between the compressor and the penetrant/developer reservoir.

Surface and immersion thermometers or temperature measurement devices with ranges of at least 40-130 F shall be available to check the test surface(s) and rinse water temperature.

7.1.4 PRE-CLEANING AND SURFACE PREPARATION

Pre-clean the surface to be examined and all areas adjacent within one inch by using one of the following methods:

A. Solvent Cleaners: Solvent cleaners shall be readily vaporized so they will evaporate from tight imperfections. Common types of solvents include naptha, paint thinner, or isopropyl alcohol. Solvent cleaning is not recommended for rust and scale. Appropriate fire and inhalation precautions should be observed.

B. Vapor Degreasing: Vapor degreasing is the preferred method for removal of organic contaminants, such as oil and grease.

C. Steam Cleaning: Steam cleaning is usually best for cleaning large items. However, it may not reach the bottom of deep imperfections. A follow-up solvent wash is often needed.

7.1.5 FINAL CLEANING

A. The final cleaning of the surface, before inspection shall be with acetone. Observe appropriate handling and inhalation precautions.

B. Allow at lease five (5) minutes (or more if conditions dictate) for final evaporation. The surface shall be completely dry.

C. Check for bleed back of any oil imperfections. Re-clean with acetone. Remove residue if any are present.

7.1.6 PENETRANT APPLICATION, RINSE AND DRYING

Once the proper type of penetrant has been selected, the Manufacturer's Application Instructions must be strictly adhered to. The following is provided as a basic guideline and should be used in addition to the Manufacturer's Application Instructions.

A. The penetrant shall be applied by dipping, brushing or spraying for 100% coverage of the desired inspection area.

B. The ideal temperature range of the part surface for most penetrants is between 50°F and 80° F. Inspection should be performed at ideal temperatures whenever possible.

C. The penetrant shall not be allowed to dry.

D. The dwell time shall be as listed below unless the penetrant manufacturer's recommendations are in conflict. If so, the penetrant manufacturer's recommendations shall govern.

SURFACE TEMPERATURE (°F)	DWELL TIME (MINUTES)	
	MINIMUM	MAXIMUM
60	20	30
80	15	25
100	12	20
120	10	15

E. The excess penetrant shall be removed from the surface with a low velocity water spray. The water temperature shall not be greater than the surface temperature.

F. Air dry or dry the surface by blotting. Do not exceed a surface temperature of 120° F if using forced warm air.

7.1.7 DEVELOPER APPLICATION (Dry Developer)

Once the proper type of developer has been selected, the Manufacturer's Application Instructions must be strictly adhered to. The following is provided as a basic guideline and should be used in addition to the Manufacturer's Application Instructions.

A. Dry powder may be applied with a soft brush, powder bulb, or powder gun.

B. The developer shall be applied within five (5) minutes after the completion of the post rinse drying operation.

C. The method of application of dry developer shall provide a uniform dusting over the entire surface being examined.

D. No runs, excessive buildup in the thread recesses or overlapping is permitted in the developer coat.

E. The developer time shall be a minimum of seven (7) minutes and not longer than thirty (30) minutes.

7.1.8 EXAMINATION

A. The examination shall be performed in a darkened area. Black light warm up period shall be a minimum of five (5) minutes.

B. Initial examination shall be made immediately after developer application in order to detect gross imperfections and contamination on the surface.

C. Final examination shall be made after a developing time of seven (7) to thirty (30) minutes.

7.1.9 INDICATION DEFINITIONS

A. A linear indication is one whose length is at least three (3) times its width.

B. A relevant indication is one caused by a mechanical discontinuity in the surface of the test piece.

C. A non-relevant indication is one caused by something other than a surface discontinuity.

7.1.10 EVALUATION OF IMPERFECTIONS

A. Any relevant indication in a threaded area is rejected.

B. Any linear indication exceeding 1/8 inch in length on its major axis is rejected unless it is proven-up by probing.

C. All non-relevant indications longer than 1/16 inch shall require re-inspection or rejection of the test piece.

7.1.11 ACCEPTANCE CRITERIA

The criteria for rejection of material with relevant indications which are probed shall be those listed in section five (5) of API RP5A5 and sections eight (8) and nine (9) of API 5CT.

7.1.12 POST INSPECTION REQUIREMENTS

A. All visible penetrant and developer shall be removed with a water spray.

B. All visible water shall be rinsed and removed after final inspection.

C. All pieces classified as containing rejected defects are to be immediately identified with the appropriate markings and, as soon as practical, physically segregated from non- rejected materials.

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SECTION 8 - END AREA INSPECTION (SHEAR WAVE)

8.1 SCOPE

This instruction covers shear wave inspection of the end areas.

8.2 PERSONNEL

Only qualified inspection personnel shall be allowed to conduct these particular shear wave methods.

8.3 EQUIPMENT

8.3.1 Ultrasonic

8.3.1.1 Portable Shear Wave Unit

8.3.1.2 Shear Wave Transducer

A. Type - Single element
B. Size - 1/4 to 1/2 inch
C. Frequency - 2.25 MHz to 5 MHz
D. Wedge angle - dependent on material thickness

8.3.1.3 Thickness Transducer

A. Type - Dual element
B. Size - 1/4 inch
C. Frequency - 5 MHz to 10 MHz

8.3.1.4 Couplant - Cellulose, water or oil

8.3.2 Miscellaneous Equipment

A. Depth gage

B. Grinder, file

8.4 ULTRASONIC REFERENCE STANDARD

8.4.1 Shear wave standard

8.4.1.1 Test Standard

The test standard shall be of similar material with nominal wall thickness, and nominal outside diameter as the pipe being tested. The standard's material shall have velocity and attenuation properties similar to that of the pipe being tested. The standard shall be defect free as to prevent interference with the detection of the machined notches.

8.4.1.2 Test Standard

The test standard shall contain both I.D. and O.D. notches in the longitudinal and transverse directions.

8.4.1.3 Test Notches

The notches shall meet the following requirements in section 9.5 below.

8.4.2 Thickness Standard

The thickness standard shall be of similar material with nominal wall thickness, and nominal outside diameter as the pipe being tested. The standard's material shall have velocity and attenuation properties similar to that of the pipe being tested. The thickness standard shall have at least two areas of thickness. One area shall be within 5% of the nominal wall thickness. The other area shall be within 5% less than 87.5% of nominal wall thickness.

8.5 CALIBRATION

8.5.1 Shear Wave Calibration

A. The inspector shall use a DSC IIW Block to verify wedge or an angle block to check for wear.

B. The inspector shall use a reference standard which meets the requirements set forth in Section 8.4.1 of this specification.

C. Locate the I.D. notch in the first leg (at half'(1/2) skip). Maximize the signal and adjust the gain to produce a signal of 80% screen height. Mark the peak of the signal with a felt tip marker.

D. Locate the I.D. notch in the third leg (at one and a half (1 1/2) skip distance). Maximize the signal and mark the peak of the signal with a felt tip marker.

E. You will have two (2) points on the CRT screen. Connect these two (2) points to correct the distance amplitude curve (DAC).

F. Locate the O.D. notch in the second leg (at one (1) full skip). Mark the peak of the signal with a felt tip marker. This will be used as a reference point to determine the approximate location of the imperfections during scanning (I.D., O.D., or midwall).

G. Conduct 8.5.1.3 thru 8.5.1.6 using longitudinal or transverse notches, depending on the type of inspection being performed.

8.5.2 Thickness Calibration

A. The thickness standard must meet the requirements of Section 8.4.2.

NOTE: In the following calibration procedure the term "High Side" will refer to the area of the standard which is within 5% of the nominal wall thickness and the term "Low Side" will refer to the area of the standard which is within 5% less than 87.5% of the nominal wall thickness...

B. Verify the "High Side" and the "Low Side" of the thickness standard using a micrometer, dial gauge, or vernier caliper with an accuracy of 0.001 inch.

C. Use the verified thickness standard to calibrate the thickness meter according to the manufactures recommended calibration procedure.

D. The thickness meter readout must match within ±0.001 inch of both the "High Side" and "Low Side" of the thickness standard.

E. Using a micrometer, mechanically measure a point on the body wall of the pipe to be inspected. (Caution should be used to ensure the contacts of the micrometer are not placed into any existing pits.) This point, to be used for calibration purpose, should be greater than 87.5% of nominal and less than 110% of nominal.

F. Place the transducer on the point which has been mechanically measured. If the reading is within ±0.001 inch, the instrument is properly calibrated and ready for use. If the reading is not within ±0.001 inch, the calibrate control (or velocity control) should be adjusted to attain the correct reading. The instrument is then properly calibrated for that pipe. If any length is to be rejected, the meter shall be calibrated on that specific length.

8.6 INSPECTION

8.6.1 Shear Wave Inspection (Transverse)

A. Prepare the pipe surface in accordance with Section 2.3.3 of this specification. A SEA using shear wave inspection must be performed a minimum distance of fifteen (15) inches beyond the end of the pipe, the threads, upset, or coupling, whichever is farthest. Perform the following inspection with an ultrasonic shear wave unit calibrated in accordance with Section 8.5.1.

B. A visual inspection of both the I.D. and O.D. surface shall be conducted on the SEA area prior to the shear wave inspection. Visually inspect for proper surface

preparation and imperfections which are not readily detected using shear wave. These types of imperfections include round bottom pits, gouges, grinds, or similar type defects which are poor reflectors of sound.

C. Apply a uniform amount of coupling to the inspection area.

D. Calibrate the shear wave unit according to Section 8.5.1 of this specification. Set the scanning sensitivity to +6dB above calibration level.

E. Scan perpendicular to the notch transverse which was used for calibration.

F. Scanning will overlap approximately 20% of the crystal diameter.

G. Scanning speed must not exceed six (6) inches per second.

H. Continue 8.6.1.2 thru 8.6.1.6 until 100% of inspection area is scanned.

I. During scanning, any signal amplitude that exceeds the reference level at +6dB, shall be investigated further.

J. Repeat 8.6.1.2 thru 8.6.1.8 with the transducer facing one hundred and eighty (180) degrees in the opposite direction.

8.6.2 Shear Wave Inspection (Longitudinal)

A. Prepare the pipe surface in accordance with Section 2.3.3 of this specification. An SEA using shear wave inspection must be performed a minimum distance of fifteen (15) inches beyond the end of the pipe, the threads, upset, or coupling, whichever is farthest. Perform the following inspection with an ultrasonic shear wave unit calibrated in accordance with Section 8.5.1.

B. A visual inspection of both the I.D. and O.D. surface shall be conducted on the SEA area prior to the shear wave inspection. Visually inspect for proper surface preparation and imperfections which are not readily detected using shear wave. These types of imperfections include round bottom pits, gouges, grinds, or similar type defects which are poor reflectors of sound.

C. Apply a uniform amount of coupling to the inspection area.

D. Calibrate the shear wave unit according to Section 8.5.1 of this specification. Set the scanning sensitivity to +6dB above calibration level.

E. Scan perpendicular to the longitudinal notch used for calibration.

F. Scanning will overlap approximately 20% of the crystal diameter.

G. Scanning speed must not exceed six (6) inches per second.

H. Continue 8.6.2.2 thru 8.6.2.6 until 100% of inspection area is scanned.

I. During scanning any signal amplitude which exceeds the reference level at +6dB, shall be investigated further.

J. Repeat 8.6.2.2 thru 8.6.2.8 with the transducer facing one hundred and eighty (180) degrees in the opposite direction.

8.6.3 Straight Beam Thickness Inspection

A. All areas with discontinuities greater than 5% of the nominal wall thickness shall be evaluated for remaining body wall.

B. Brush the area to remove all loose material from the tube surface. Apply a uniform amount of coupling to the prove-up area.

C. Place the transducer so that the sound barrier between the dual elements of the probe is perpendicular to the main axis of the pipe.

D. Allow the thickness reading to stabilize.

E. Readings found to have less than the minimum wall shall be re-evaluated once the calibration of the unit is verified.

F. Readings shall be closely evaluated to assure that laminar type imperfections are not interpreted as actual wall readings.

G. Areas with less than the minimum wall shall be identified upon rejection.

8.7 DISCONTINUITY EVALUATIONS

Evaluation criteria shall be set forth by API-5A5 and/or the Customer Specification.

8.8 ACCEPTANCE AND REJECTION CRITERIA

Acceptance and rejection criteria shall be governed by API Specification and/or the Customer Specifications.

REVISION HISTORY

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Complete Revision History	--

SECTION 9 - AUTOMATED INSPECTION (EMI)

9.1 CALIBRATION PROCEDURE

9.1.1 Reference or Calibration Standard

In an effort to calibrate the EMI unit in such a manner to yield the best possible combination of signal to noise ratio, repeatability, and defect detection, the use of a calibration reference is mandatory. This calibration reference shall be made from a joint of pipe of equal size, weight and grade as the material being inspected. If the proper calibration standard is not available, one must be made from the order being inspected. When using the customer's pipe as a reference standard, all artificial discontinuities shall be placed in areas of sufficient wall thickness, to permit complete removal, without causing rejection. Only with customer approval can artificial discontinuities which cause rejection (such as a thru wall hole) be placed in the customers pipe. As a minimum requirement, the standard must contain all of the following.

A. Wall Reduction.
Thin wall section with 10% to 11.5% wall reduction.

B. Two Longitudinal Notches.
One on the O.D. and one on the I.D. surface. The notch depth shall be no greater than 10% for API 5CT Groups 1 and 2 tubulars, and the depth shall be 5% for API 5CT Groups 3 and 4 tubulars. The width shall be between 0.006 and 0.040 inches. The length shall be between 0.500 and 2.000 inches.

C. Transverse Notch.
Two transverse notches, one on the O.D. and one on the I.D. surface. The notch depth shall be no greater than 10% for API 5CT Groups 1 and 2 tubulars, and the depth shall be 5% for API 5CT Groups 3 and 4 tubulars. The width shall be between 0.006 and 0.040 inches. The length shall be between 0.500 and 1.000 inches.

D. Drilled Holes.
A drilled hole with either a 1/8 or 1/16 inch diameter. It is recommended that 1/8 inch diameter hole be used for API 5CT Groups 1 and 2 tubulars, and a 1/16 inch diameter hole be used for API 5CT Groups 3 and 4 tubulars. The depth of the hole shall be 10% to 100% of the wall thickness depending on the sensitivity desired.

Note: If the reference standards are to be made using the customer's pipe, the customer shall approve any drilled holes which exceed rejection limits.

9.1.2 Systematic SOP for the NDT EMI Unit

The start up and operation of this unit is covered in the OEM manual for model # 13640 & 13640B in the annex to this work instruction.

REVISION HISTORY

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Complete Revision History	--

SECTION 10 - AUTOMATED INSPECTION (UT)

10.1 SCOPE

This section covers the use of ultrasonic test methods and techniques for the inspection of oil country tubular goods. Angle and straight beam methods are employed using a high speed scan method for the detection of mid-wall discontinuities, O.D. and I.D. surface discontinuities, and wall thickness variation.

10.1.1 Angle Beam Test

Sixteen (16) transducers can be used for angle beam testing. These transducers can be configured in any orientation. Unless otherwise specified by the Customer, the transducers are configured to "look" every 22.5 degrees, starting with 0 degree. (0 and 180 degree being perpendicular to the main axis of the pipe)

10.1.2 Straight Beam Test

Four (4) transducers can be used for wall thickness and lamination. Unless otherwise specified by the Customer, two (2) wall thickness transducers are used. The: transducers are configured in a manner that allows one transducer to be position at each end of the head assembly. Wall thickness measurements are taken within one inch from the pipe ends, threads, upset, or couplings, whichever is farthest.

10.2 PERSONNEL
Inspection personnel conducting tests shall be required to meet qualifications set forth by Technical Industries Inc. Training Program for Qualification and Certification of Employees.

10.3 TEST EQUIPMENT (electronic)
The flaw channels and wall thickness measurements shall be of pulse echo type and shall be capable of distinguishing the reference notches as required in the calibration procedure.

10.3.1 TRANSDUCERS
Transducer type, size, angle, and frequency shall be determined by the pipe grade, diameter, thickness, condition, and sensitivity of the inspection required.

10.3.1.1
Transducers may be single, dual element focused and unfocused. Single or dual element transducers are chosen as a matter of operator preference, or availability of space in certain head configurations. A dual element transducer, as used in this section, refers to two (2) elements mounted in a single housing. These elements function independently of each other and are positioned to "look" 180 degrees opposite of each other. All other variables being equal, a dual element transducer will function in the same way as two (2) single element transducers positioned to "look" 180 degrees opposite of each other, the difference being the location and space used in the head assembly.

Focused and unfocused refer to straight beam testing. Focused transducers are allowed as long as the focal area on the I.D. surface is calculated and used as the effective beam width in the helix calculation and/or other calculations which use effective beam.

10.3.1.2
Type - piezoelectric elements as required, to produce repeatable signals of acceptable amplitude from the reference standard.

10.3.1.3
Size - element size must not exceed one square inch. (1)

10.3.1.4
Angle - The transducer angle used for testing shall be between the first critical angle and 45 degrees (angle of the shear wave in the material being tested). A 45 degree shear wave angle shall be used whenever possible and/or practical. Maximum thickness or penetration shall be verified using the following formula:

Maximum Wall Thickness

Max d = 0.5(1-sin x) D

Where: D

= wall thickness or penetration depth

= diameter

= shear wave angle in the test material

NOTE: Max d must equal a minimum of nominal wall plus 10%

10.3.1.5
Frequency - Frequency Range is from 1 MHz to 10 MHz as required to produce repeatable signals of acceptable amplitude from the reference standard. For angle beam testing, a 2.25 MHz or 5 MHz. generally provide the best results. Depending upon the material properties (grain structure, surface condition, etc.) and the sensitivity required for inspection, other frequencies can be used.

NOTE: The frequency and size of the transducer must be selected to ensure that the near field does not extend below 87.5% of the nominal thickness.

10.3.1.4 Certification
All transducers shall have specific parameters and be certified by the manufacturer to actual profiles and frequency spectrums. Certificates shall be made available for review prior to any inspection.

10.3.2 RECORDING EQUIPMENT

10.3.2.1 STRIP CHART EQUIPMENT for all ultrasonic (Longitudinal, straight beam, test orientations, transverse, ob

A. Shall provide a permanent strip chart record of the ultrasonic inspection with individual recording for all ultrasonic channels (longitudinal, wall thickness, transverse & oblique).

B. The recorder shall provide a continuous trace of all significant signal in the gated area.

C. The recorder shall be equipped with variable speed sensitivity and, variable input signal amplification.

D. The recorder chart shall be clearly visible, full scale, over the entire range. The recorder shall be capable of producing at least a ten (10) inch chart on standard range III material.

E. The recorder signal response time shall be fast enough to display the full pen deflection of signals that exceed the threshold settings.

10.3.3 MECHANICAL HANDLING SYSTEM

10.3.3.1
The traversing mechanism (gantry) shall maintain a constant rate of travel while the tube's rotation remains constant at a fixed position. This allows the transducers (straight and shear) to provide the proper coverage. Coverage shall be a minimum of 110%.

10.3.3.2
Loading and unloading shall be conducted in a safe manner as not to injure material or personnel. The unit shall also be capable of handling and transporting pipe with thread protectors and couplings installed.

10.4 REFERENCE STANDARD
The standard shall be of similar material, nominal wall thickness, and nominal outside diameter as the pipe being tested. The tube shall be defect free within an eight (8) inch area either side of the artificial discontinuities. This is to prevent interference with detections of the artificial discontinuities.

10.4.1
The angle beam standard shall contain both I.D. and O.D. notches of longitudinal, transverse and oblique directions. The notches on the same surface shall have a minimum distance of eight (8) inches of longitudinal separation between them to enable proper signal discrimination of the chart recorder.

10.4.2

The notches will have a depth of 5% and/or 10% of nominal wall thickness and maximum width of 0.040 inch.

10.4.3
The notch depth shall be measured from the circular surface to the maximum and minimum penetration of the notch. Notch depth shall be verified with a blade micrometer, ultrasonic thickness meter, or by impression molds.

10.4.4
Oblique reference notches on the I.D. and O.D. shall be of 45 degree angles with left and right hand directions. A through wall hole of 1/16 inch diameter and a partially through wall hole of 1/8 inch diameter may also be used on the reference standard. The through wall hole and partial through wall hole are useful for setting sensitivity.

NOTE: A through wall hole, partial through wall hole, or any other artificial discontinuities which could cause rejection of the Customers material must be approved by the Customer prior to processing of the reference standard.

10.4.5
Notch depth shall be uniform along its entire length. Notch length shall be approximately 1 inch.

10.4.6
Certification of notch configuration and depth will be maintained on file and available upon request.

10.4.7
The wall thickness test standard shall contain a wall reduction area of 5% and/or approximate 10% with dimensions of 1 inch X 1 inch.

10.5 SETUP AND CALIBRATION FOR ET-SERIES ULTRASONIC TEST SYSTEM
The setup and calibration procedures set forth in the following paragraphs is the minimum requirements necessary to properly inspect O.C.T.G. and related material with the ET-SERIES ultrasonic inspection system. It must not be misconstrued as the only possible approach or requirement. Special situations set forth by the Customer or the material being inspected may require limited deviation from this procedure.

10.5.1 Pre-Power-up Procedure
For more detail on Pre-Power-up Procedures see the Technical Industries Maintenance Schedule for ET-SERIES Inspection Systems.

A. Prior to Power-up the entire machine shall be visually inspected for loose, broken, or misadjusted components. This should include all mechanical and electrical components. In the event that any inconsistencies are noted, they will be remedied prior to continuing.

B. Verify proper fluid levels and lubrication.

10.5.2 Initial Power-up

A. Check to insure that the emergency stop switch is in the normal position. Press the system reset switch twice. Closing of the mains primary power relay circuit should be audibly noted.

B. Set all breakers on mains input control panel to their ON position. An illuminated red neon status indicator should be noted above all breakers as to the positive availability of mains power. A check of the mains voltmeter should indicate a voltage of 115.0 volts ~ 10%.

C. Check the status indicator panel for an illuminated red light emitting diode, indicating the presence of positive low voltage control power. Simultaneously check for a positive indication of power on the micro-wiz totalizer. All electronic equipment will be energized for a minimum of thirty (30) minutes to insure a proper warm up time has occurred prior to the beginning of the calibration procedure.

D. The three phase breakers on the Sumitomo controllers should now be engaged. An indication of the current frequency setting should be present on both led status indicators of the controllers.

E. Turn the closed circuit T.V. monitors to their ON position. The C.R.T. of all three closed circuit T.V. monitors should now be checked for proper ~illumination. Adjust the gantry lighting, monitors, and cameras as required for a proper visual presentation.

F. The Panel View display should be present with the Main Menu screen visible. Move to the Status screen. Verify that any indication which is displayed in a red blinking output is within normal parameters for this phase of operation. Move back to the Main Menu screen and select the Manual screen. The Panel View will display a Security screen. Enter the proper security code to continue to the Manual screen. Momentarily activate the Head and Couplant buttons to insure that air and water are present and within normal operating parameters.

10.5.3 Mechanical Set-up

A. The roller position shall be adjusted to the proper "V" depth for the pipe size being inspected. The adjustable bearing mount shall be positioned as to allow the pipe to rest on the inside of the unit rollers at approximately 45 degrees.

B. Insert the correct head assembly for the type of pipe to be inspected (Casing or Tubing). Connect the water hoses and the transducer interconnection cables to the main gantry assembly.

C. Attach the proper wear shoes. The wear shoes will be checked to insure they are of proper size, previous wear is not excessive, and that wear is even with respect to the radius of the shoe.

D. Adjust the lateral test head position assembly. The tubing head shall be centered directly above the pipe casing head and be centered directly above the pipe with the spring loaded shoe assemblies contacting the pipe surface at a 45 degree angle as referenced to the top center longitudinal axis of the pipe.

E. Adjust the vertical height of the test head. To maximize head stability, adjust the vertical height to provide the shortest stroke of the air retraction cylinder necessary to allow the test head-to safely clear the pipe ends.

F. Adjust the "DOUP" control. The "DOUP" shall be adjusted to provide an adequate pressure between the shoes and the pipe surface. This pressure should not exceed that which is necessary to invoke a minimum leakage around the outer perimeter of the wear shoes and a maximum output from the cavity drain tubes.

10.5.4 Preliminary Calibration and set-up

This procedure is performed without the use of test notches. Properly performed, this procedure is very adequate in establishing instrument settings and inspection parameters which are very close to those of the final calibration.

A. Insert the transducers into the shoe assembly. Verify transducer face clearance in reference to shoe face as to insure that no direct transducer to pipe contact is possible. Each transducer shall be initially set visually to the approximate angle of the induced imperfection that it will be later maximized for. Gently lower the transducer until it is in contact with the pipe surface. Maintaining the approximate angle, raise the transducer approximately one sixteenth of an inch above the pipe surface. This procedure shall be completed for each transducer and each angle which will be included in the final set-up.

B. The appropriate value for the diameter of material being tested will be entered into the micro-wiz totalizer. Verify the proper rotational speed by placing a crayon or paint marking on the joint. Rotate the joint and count the revolutions for one minute to obtain the actual RPM. If necessary make input changes to the totalizer to calibrate it.

C. Rotational speed and gantry speed will be set to achieve a helix setting appropriate for the inspection process. The inspection helix will be verified by scribing on the pipe with a sharp pencil at helix setting of 0.25 inches and 0.50 inches. Measure the scribe using a thread ruler or similar ruler with a minimum of 1/32 inch increments. If necessary make input changes to the totalizer to calibrate it. Three different combinations of rotational speeds and gantry speeds may be entered into the helix control panel. This allows changes in speeds while maintaining the proper helix· This is done to compensate for joints that may be bent, therefore requiring lower speeds to maintain adequate shoe ride and coupling during the entire inspection process.

Lower the test head onto the material. Energize the water solenoid and start the pipe rotation. For the purpose of preliminary calibration, the RPM shall be lower than that required to produce a pulse spacing that is 80% or less than the crystal dimension, in the direction of rotation. The helix shall be 80% or less than the crystal dimension, in the direction of gantry travel.

D. Preliminary KSE Set-up

1. Adjust system gain to insure adequate presentation on the ST-2 oscilloscope.

2. Verify the presence of an active transducer on all channels by scanning through all channels using the screen selector switch.

3. Set the individual gain control knobs on the CA-22 modules to 50%.

4. Position the initial pulse for each channel using the controls found on the transmitter SD-23 modules.

5. Insure that no reject is being used in the inspection process. This is accomplished by adjusting the AM-20 module reject control to it's full counter-clockwise position.

6. Set the amplitude attenuator control on the AM-20 module to it's full counter-clockwise position.

7. Set the band-pass filter frequency control to an equivalent transducer frequency.

8. Turn all damping controls on the KSE's mainframe to their minimum position.

9. Adjust the ST-2 oscilloscope for a proper base line presentation.

10. Set the repetition rate to the maximum that does not cause injurious rap-around effect to occur.

E. Starting with channel one (1) adjust the system gain by using the surface noise as standard level input. You should see surface noise from both the I.D. and O.D. surface. While scanning the tube, adjust the I.D. surface noise, using the system gain, to a level approximately 10% below threshold level. Using the surface noise, adjust the I.D. and O.D. gated area. Continue with the remaining channels using the individual gain controls.

F. The compression wave transducers will be set using an area that has been verified, as to wall thickness, by the use of a calibrated mechanical instrument. A

portable U.T. instrument will be utilized to set proper height of' the transducers as to maximize multiple echoes.

10.5.5 Selecting a Calibration Standard

A. Select a joint that is reasonably straight. The RPM allowable will be the maximum Calibration Standard or that of the RPM formula, whichever is less.

B. Scan the joint to insure that the area where test notches will be introduced is free of imperfections which could interfere with the detection of test notches. If any imperfections are noted, another joint should be selected.

10.5.6 Preparing a Calibration Standard

Preparation of the Calibration Standard shall be in according to Customer Specification or Section 10.4 of this specification.

10.5.7 Final Calibration

Calibration shall be conducted at the beginning and end of each shift, with calibration checks being made every four (4) hours or fifty (50) joints, whichever comes first. Calibration shall consist of four (4) consecutive passes over all test notches. The signal response from each notch must be at least 80% of the signal height produced by the previous calibration.

A. Using a portable U.T. instrument, set the proper angle and height of each transducer. All transducers will be maximized for amplitude on a notch whose depth and orientation is congruent with customer specifications or Section 10.4 of this specification. Care must be taken to insure that no transducers are touching the pipe surface.

B. Determination for each channel shall be made as to whether internal or external surface will be displayed first in the gated area. This determination is based on several factors (ie. material surface condition, material thickness, and material "noise").

C. Gain settings shall be set in such a manner that the second signal displayed will be set to 100% of full screen height. This type of setting permits the greatest overall sensitivity and promotes the best in inspection quality. A system gain setting on the AM-20 module will be selected as to accommodate all channels on the flaw detection unit. The CA-22 module will be set as to accommodate each individual channel's gain as necessary.

D. Gate length and time domain shall be set as to include any reflection that may occur for both I.D. or O.D. surface.

E. The ET-26 module's marker gate will be set as to separate I.D. and O.D. signals. The gate inversion switches shall be set as to properly discriminate between I.D. and O.D. indications on the alarm panel and the strip chart recorder.

10.6 ULTRASONIC INSPECTION PARAMETERS

10.6.1 The inspection shall be conducted under the same conditions as used in the calibration. Which are; helix, couplant, transducers, instrument settings, (dB, gate, reject control, etc.) to insure a uniform and repeatable inspection.

10.6.2
To ensure proper material coverage the following variables must be known and controlled.

10.6.2.1
The helix length must be less than the effective beam length of the transducer. This may be mathematically expressed as:

Maximum Helix Length

$V < N \times RPM \times L/12$

Where: V = pipe axial velocity, ft/min.

RPM = rev/min.

L= beam length in inches

N= number of transducers if identical type and orientation.

10.6.2.2
Verify the scanning helix line with a sharp pencil or marker as the gantry and transducer head traverses along the rotating tube.

10.6.2.3
The tube rotational speed shall be governed by the following parameters to be compatible with the pulse repetition rate.

Maximum RPM

$60 \times W \times K / Pi \times D \times P$

Where: W = effective beam width in inches (use beam profile of smallest width.)

K = instrument pulse repetition rate for each individual channel.

D = tube O.D. (inches)

P = pulses per position minimum = 3
Pi = 3.1416

RPM= maximum revolutions per minute of the tube during actual testing.

10.6.3
KSE-28 shall be calibrated for vertical and horizontal linearity per ASTM E-317 every six months.

10.7 RECALIBRATION
Recalibration of the system shall be required by the following conditions.

10.7.1
After re-alignment of the ultrasonic transducer angles or water path.

10.7.2
With a change of couplant, instrument settings, scanning speed, operating personnel, completion of job, equipment left unattended for over one (1) hour, loss of power or power surge, and beginning, middle and end of the workshift.

10.7.3 When during recalibration a significant change in signal response (>20%) is noted, the required calibration shall be re-established and all the material scanned since the proceeding calibration shall be re-inspected.

10.8 INDICATION FOR PROVE-UP

10.8.1
Indications equal to or greater than the amplitude of the minimum reference signal shall be marked for prove-up.

10.8.2
Conditions which render the material unable to be inspected shall be brought to the Customers attention.

Example=O.D. /I.D. surface noise above 25% full screen height or pipe out of straightness.

10.8.3
Wall thickness irregularities which are 3% above minimum wall shall be marked for prove-up.

10.9 CHART RECORDINGS IDENTIFICATION

10.9.1
Prior to the first calibration of the order, the following information shall be entered on the recordings.

A. Customer
B. Material description (size, wt., grade, thd.)
C. Specification

D. Approved deviations
E. Operator
F. Customer special requests

10.9.2
During calibration all signals of notches shall be identified to location, depth, orientation with time and date.

REVISION HISTORY

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Complete Revision History	--

SECTION 11 - PROVE-UP INSPECTION PROCEDURE

11.1 SCOPE

This procedure covers the location and evaluation of discontinuities discovered by high speed scanning.

11.2 PERSONNEL

Only qualified inspection personnel that meet Qualifications shall be allowed to conduct those prove-up methods. Personnel particular

11.3 EQUIPMENT

11.3.1 Magnetic Particle Inspection (MPI)

A. AC Yoke (dry)

B. Magnetic Particle (dry)

11.3.2 Ultrasonic

11.3.2.1 Portable Shear Wave Unit

11.3.2.2 Shear Wave Transducer

A. Type - Single element
B. Size - 1/4 to 1/2 inch
C. Frequency - 2.25 MHz to 5 MHz
D. Wedge angle - dependent on thickness

11.3.2.3 Thickness Transducer

A. Type - Dual element
B. Size - 1/4 inch
C. Frequency - 5 MHz to 10 MHz

11.3.2.4 Couplant: Cellulose, water or oil Miscellaneous Equipment

11.3.3.1 Depth gauge

11.3.3.2 Grinder, file

11.4 ULTRASONIC REFERENCE STANDARD

11.4.1 Shear Wave Standard

11.4.1.

The standard shall be of similar material with nominal wall thickness, and nominal outside diameter as the pipe being tested. The standard shall be defect free as to prevent interference with detection of machined notch.

11.4.1.2

The standard shall contain both I.D. and O.D. notches longitudinal and transverse directions.

11.4.1.3

Notches shall meet requirements as listed in 10.4.6 and 10.4.7 the following 10.4.3, 10.4.4,

11.4.2 Thickness Standard

The curved thickness calibration standard should be of the same diameter, nominal wall thickness and 87 1/2% of remaining wall thickness for optimum calibration.

11.5 CALIBRATION

11.5.1 Magnetic AC Yoke

AC Yoke is to be of adjustable leg type when used on all tubes of 5 1/2 O.D. and smaller and capable of lifting a ten pound weight with the legs of the yoke set for maximum pole spacing.

11.5.2 Shear Wave Calibration

A. Inspector shall use DSC Block or IIW Block to verify wedge angle for excessive wear.

B. Inspector shall use reference standard per 10.1.1 description.

C. Locate the I.D. notch in the first leg (at half (1/2) skip). Maximize the signal and adjust the gain to produce a signal of 80% screen height. Mark the peak of the signal with a felt tip marker.

D. Locate the I.D. notch in the third leg (at one and one half (1-1/2) skip distance). Maximize the signal, without adjusting the gain, and mark the peak of the signal with a felt tip marker.

E. You will have two (2) points screen. Connect these two (2) form the distance amplitude curve (DAC).

F. Locate the O.D. notch in the second leg (at one (1) full skip). Mark the peak of the signal with a felt tip marker. This will be used as a reference point to determine the approximate location of the imperfections during scanning (I.D., O.D., or midwall).

G. Obtain curved calibration which has same curvature and thickness as the material to be inspected.

H. Select thickness which correspond to 100% and 87% of nominal wall thickness of the pipe that is to be inspected.

I. Calibrate between 100% and 87 1/2% of nominal wall, using zero and calibrate controls.

J. Mechanically measure a point on the length of pipe to be inspected.

K. Place transducer on point which has been mechanically measured. If reading is within ±.001" the instrument is calibrated. If the reading is not within .001" the calibration control should be adjusted to attain the correct reading.

11.6 PROVE-UP INSPECTION SEQUENCE

Areas marked for flaw indications shall be evaluated 4" on each side of the marked area, by the following sequences of inspections.

11.6.1 Visual Inspection

A. Inspect marked areas for visual discontinuities (pits, gouges, etc.) or foreign objects adhering to tube.

B. Visually verify material grade and circle with metal marker.

11.6.2 Magnetic Particle Inspection

A. Marked areas shall be clean and dry.

B. Conduct AC yoke inspection prove up per 2.5.1 over area with leg spacing adjusted and field oriented perpendicular to defect orientation

C. Powder the area between legs for indications which shall be evaluated to depth.

D. Repeat steps 11.6.2.1 - 11.6.2.4 through 100% of the marked circumferential area.

11.6.3 Shear Wave Inspection

If the indication is not detected during 11.6.1 and 11.6.2, inspect the marked area with an ultrasonic shear wave unit calibrated in accordance with Section 11.5.2.

A. Brush area to remove all loose material from tube surface. Apply uniform amount of couplant to marked area two (2) inches on each side of mark.

B. Scan perpendicular to orientation of the detected flaws.

C. Scanning sensitivity shall be set at 80% reference amplitude + 6 dB's.

D. Repeat 11.6.3.3, transducer facing 180 degrees opposite direction.

E. Continue 11.6.3.2 - 11.6.3.3 until 100% of tubes prove-up area is scanned.

F. Scanning will overlap 20% of crystal diameter.

G. Scanning speed should not exceed 6" per second.

H. During scanning any signal amplitude which is over 20% reference + 6 dB's shall be investigated further.

11.6.4 Straight Beam Thickness Inspection

A. Brush area to remove all loose material from tube surface. Apply uniform amount of couplant to prove-up area.

B. Place the transducer so that the sound carrier between the dual elements of the probe is perpendicular to the main axis of the pipe.

C. Allow the thickness readings to stabilize.

D. Readings found to have less than minimum wall shall be re-evaluated once calibration of unit is verified.

E. Readings shall be closely evaluated to assure that laminar type imperfections are not interpreted as actual wall readings.

F. Areas with less than minimum wall identified shall be rejected.

11.7 DISCONTINUITY EVALUATIONS

Evaluation criteria shall be set forth by API-5A5 and/or customer specification.

11.8 ACCEPTANCE AND REJECTION CRITERIA

Acceptance and rejection criteria shall be governed by API specification and/or customer specifications.

REVISION HISTORY

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Complete Revision History	--

SECTION 11 - PROVE-UP INSPECTION PROCEDURE

11.1 SCOPE

This procedure covers the location and evaluation of discontinuities discovered by high speed scanning.

11.2 PERSONNEL

Only inspection personnel that meet Qualifications shall be allowed to conduct these prove-up methods.

11.3 EQUIPMENT

11.3.1 Magnetic Particle Inspection (MPI)

A. AC Yoke (dry)

B. Magnetic Particle (dry)

11.3.2 Ultrasonic

11.3.2.1 Portable Shear Wave Unit

11.3.2.2 Shear Wave Transducer

A. Type - Single element
B. Size - 1/4 to 1/2 inch
C. Frequency - 2.25 MHz to 5 MHz
D. Wedge angle - dependent on thickness

11.3.2.3 Thickness Transducer

A. Type - Dual element
B. Size - 1/4 inch
C. Frequency - 5 MHz to 10 MHz

11.3.2.4 Couplant: Cellulose, water or oil Miscellaneous Equipment

11.3.3.1 Depth gauge

11.3.3.2 Grinder, file

11.4 ULTRASONIC REFERENCE STANDARD

11.4.1 Shear Wave Standard

11.4.1.

The standard shall be of similar material with nominal wall thickness, and nominal outside diameter as the pipe being tested. The standard shall be defect free as to prevent interference with detection of machined notch.

11.4.1.2

The standard shall contain both I.D. and O.D. notches longitudinal and transverse directions.

11.4.1.3

Notches shall meet requirements as listed in Work Instruction Section 10.4 covering reference standard requirements.

11.4.2 Thickness Standard

The curved thickness calibration standard should be of the same diameter, nominal wall thickness and 87 1/2% of remaining wall thickness for optimum calibration.

11.5 CALIBRATION

11.5.1 Magnetic AC Yoke

AC Yoke is to be of adjustable leg type when used on all tubes of 5 1/2 O.D. and smaller and capable of lifting a ten pound weight with the legs of the yoke set for maximum pole spacing.

11.5.2 Shear Wave Calibration

A. Inspector shall use DSC Block or IIW Block to verify wedge angle for excessive wear.

B. Inspector shall use reference standard meeting the requirements of Work Instruction Section 10.4.

C. Locate the I.D. notch in the first leg (at half (1/2) skip). Maximize the signal and adjust the gain to produce a signal of 80% screen height. Mark the peak of the signal with a felt tip marker.

D. Locate the I.D. notch in the third leg (at one and one half (1-1/2) skip distance). Maximize the signal, without adjusting the gain, and mark the peak of the signal with a felt tip marker.

E. You will have two (2) points screen. Connect these two (2) form the distance amplitude curve (DAC).

F. Locate the O.D. notch in the second leg (at one (1) full skip). Mark the peak of the signal with a felt tip marker. This will be used as a reference point to determine the approximate location of the imperfections during scanning (I.D., O.D., or midwall).

G. Obtain curved calibration which has same curvature and thickness as the material to be inspected.

H. Select thickness which correspond to 100% and 87% of nominal wall thickness of the pipe that is to be inspected.

I. Calibrate between 100% and 87 1/2% of nominal wall, using zero and calibrate controls.

J. Mechanically measure a point on the length of pipe to be inspected.

K. Place transducer on point which has been mechanically measured. If reading is within ±.001" the instrument is calibrated. If the reading is not within .001" the calibration control should be adjusted to attain the correct reading.

11.6 PROVE-UP INSPECTION SEQUENCE

Areas marked for flaw indications shall be evaluated 4" on each side of the marked area, by the following sequences of inspections.

11.6.1 Visual Inspection

A. Inspect marked areas for visual discontinuities (pits, gouges, etc.) or foreign objects adhering to tube.

B. Visually verify material grade and circle with metal marker.

11.6.2 Magnetic Particle Inspection

A. Marked areas shall be clean and dry.

B. Conduct AC yoke inspection prove up per 11.5.1 over area with leg spacing adjusted and field oriented perpendicular to defect orientation

C. Powder the area between legs for indications which shall be evaluated to depth.

D. Repeat steps 11.6.2.1 - 11.6.2.4 through 100% of the marked circumferential area.

11.6.3 Shear Wave Inspection

If the indication is not detected during 11.6.1 and 11.6.2, inspect the marked area with an ultrasonic shear wave unit calibrated in accordance with Section 11.5.2.

A. Brush area to remove all loose material from tube surface. Apply uniform amount of couplant to marked area two (2) inches on each side of mark.

B. Scan perpendicular to orientation of the detected flaws.

C. Scanning sensitivity shall be set at 80% reference amplitude + 6 dB's.

D. Repeat 11.6.3.3, transducer facing 180 degrees opposite direction.

E. Continue 11.6.3.2 - 11.6.3.3 until 100% of tubes prove-up area is scanned.

F. Scanning will overlap 20% of crystal diameter.

G. Scanning speed should not exceed 6" per second.

H. During scanning any signal amplitude which is over 20% reference + 6 dB's shall be investigated further.

11.6.4 Straight Beam Thickness Inspection

A. Brush area to remove all loose material from tube surface. Apply uniform amount of couplant to prove-up area.

B. Place the transducer so that the sound carrier between the dual elements of the probe is perpendicular to the main axis of the pipe.

C. Allow the thickness readings to stabilize.

D. Readings found to have less than minimum wall shall be re-evaluated once calibration of unit is verified.

E. Readings shall be closely evaluated to assure that laminar type imperfections are not interpreted as actual wall readings.

F. Areas with less than minimum wall identified shall be rejected.

11.7 DISCONTINUITY EVALUATIONS

Evaluation criteria shall be set forth by API-5A5 Section 19 and/or customer specification.

11.8 ACCEPTANCE AND REJECTION CRITERIA

Acceptance and rejection criteria shall be governed by API specification and/or customer specifications.

REVISION HISTORY

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Complete Revision History	--
E.	Changed first sentence of 11.2 Changed 11.4.1.3 to reference Sec. 10.4 of WI. Changed 11.4.2.B to reference Sec. 10.4 of WI. Changed 11.6.2 B to reference 11.5.1 of this WI. Changed 11.7 to reference API 5A5 Sec. 19 .	1-03-2012

SECTION 12 - POST PROVE-UP

12.1 PRIOR TO FINAL REPORT

Before final report is completed, all inspection records will be gathered immediately upon the completion of the job. The inspector will make sure that:

A. The final count of rejects, good joints, and total joints are correctly reflected in the record

B. Each Joint number shown to be rejected in the record matches the joint number on the rejected pipe

C. All joints have been banded and stenciled properly

D. All joints have been tallied and verified as accurate according to incoming records.

12.2 FINAL REPORT

Upon completion of all prior procedures and record gathering, a final report or "Field Inspection Report" will be prepared immediately and sent to the customer or given to his representative. This report will contain all the information listed in Section 1.6 of this document.

REVISION HISTORY

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Complete Revision History	--

SECTION 13 - THREAD GAGING

13.1 SCOPE

13.1.1 Objective

Technical Industries, Inc. utilizes a standard operating procedure covering the full magnitude of thread inspection. This document is primarily intended to be used as a minimum requirement, while specifically recognizing eight (8) round and Buttress threads, thread gauges and gauging practice for internal and/or external threads on casing and tubing.

13.1.2 Applicable Specifications

API Std. 5B includes thread gauge procedures and tolerances for Buttress, Eight (8) round, Ten (10) round, 11-1/2 v and Extreme Line threads. However, this SOP outlines only Eight (8) rounds and Buttress since they are the most common thread form used on oil country casing and tubing.

Information, excerpts and procedures specified herein complies with standards and specifications outlined in the following API manuals:

API STD 5B, 1987

API RP5A5, 1988

API RP5B1, 1988

API RP5CT, 1988

13.2 PRE-INSPECTION GUIDELINES

13.2.1 Temperature

Dial Gauges used in performing any thread inspection should be exposed to the exact temperature conditions as the product being inspected. The exposure time may vary, but is verified prior to the inspection in order to eliminate any and all temperature differences.

13.2.2 Calibration

Dial gauges used for the inspection of threads are "Precision Instruments". The handling, care, and maintenance of these delicate instruments are of the utmost importance and are to be handled only by a qualified thread inspector. The care applied in the every day use of each gauging instrument assures that "well defined" and desired thread inspection.

When any gauge used in this highly sensitive inspection is dropped or jarred the gauge shall be immediately checked over and re-calibrated prior to further inspection of any kind.

In all thread inspections, the gauging instruments being used at the time are re-calibrated after the first 25 pieces have been inspected or whenever a "reject" is found.

This special attention given to the gauges utilized in thread inspection helps insure quality in the outcome of the overall inspection itself as well as the party to which this procedure is entrusted.

13.3 INSPECTION FLOW

Technical Industries, Inc. utilizes an inspection system, listed below in order of importance. Applied in this particular sequence this system assures an accurate inspection as well as back up verification:

VISUAL
[Thread Form, Black Crested Threads or Bevel and Mechanical Damage] (Lc), Chamfer
THREAD LENGTH [L4, Al, NL]

THREAD HEIGHT

COATING THICKNESS

LEAD

THREAD RUN-OUT [Buttress]

TAPER

PITCH DIAMETER OUT OF ROUND/OVALITY

POWER-TIGHT MAKE-UP

If threads are rejected by any of the first few steps, the last steps of the system should not have to be performed. This can prevent any damage to delicate gauges and save time when doing a thread inspection.

For Example: If threads are rejected for appearance (cut threads, torn threads, etc.) the rest of the inspection could be deleted; such as measuring thread height, lead, taper and pitch diameter.

Although there are no set tolerances for Pitch Diameter and out of round/ovality prescribed by API, Technical Industries, Inc. tolerances are based on data contained in the API 5B, RP5B1, and power-tight make-up observations.

13.4 INSPECTIONS

13.4.1 Visual Inspections

Visual Thread Inspection (VTI) is a service for locating thread imperfections without the use of magnetic particles or thread gauging and inspection tools. Visually evident manufacturing defects or mechanical damage to the threads are detected by this inspection.

API STD 5B provides the parameters that are the most relevant to visual thread inspection.

To determine the Lc refer to API STD 5B length of field end threads, from which these tables were made.

Note: Since the internal threads do not have an Lc area, all of the threads within the interval from the counterbore to a plane located at a distance J plus one thread turn from the center of the coupling, are to be inspected to the Lc area requirements.

Those imperfections located in the Lc area have a different set of criteria for acceptance and rejection than those imperfections not in the Lc area. Therefore, it is often necessary to measure an imperfection distance from the end of the pipe to determine if it is in the Lc area or beyond.

While visually inspecting the external threads, the inspector should slowly roll individual lengths at least one full revolution checking for imperfections. Each length is rolled again while visually inspecting the internal threads.

13.4.1.1 Imperfections

Listed below are imperfections that may cause threads to be defective:

A. Broken Threads
B. Cuts
C. Grinds
D. Shoulders
E. Seams
F. Threads not fully crested (includes black-crested threads)
G. Laps
H. Pitted Threads
I. Dents
J. Tool Marks
K. Torn Threads [tears]
L. Handling Damage
M. Thick Threads
N. Narrow Threads [shaved threads]
O. Galled Threads
P. Arc Burns
Q. Cracks
R. Chattered Threads
S. Distorted or Drunken Threads
T. Threads not extending to the center of the coupling.

U. Any other imperfections that break the continuity of the thread in the Lc area

13.4.1.2 Black-Crested Threads

Black-crested threads on round threads are unacceptable within the Lc area.

On buttress casing two black crested threads that exceed twenty-five percent (25%) of the circumference is cause for rejection. More than two black crested threads is cause for rejection.

Note: Threads that are not full-crested have been and continue to be referred to as "black crested threads" because the original mill surface has not been removed. The term "black crested thread" is a useful descriptive term; however, it is acknowledged that there can also be non full-crested threads that may not be black.

13.4.1.3 Chamfers

Chamfers on the pipe ends have no effect on the sealing capability of the threads. However, chamfers must extend 360 degrees around the ends of the pipe, they must not produce a razor edge at the ends, and no thread may produce a feather-edge. The starting thread must run out on the chamfer surface and not the end of the pipe.

The surfaces of the chamfers need not be perfectly smooth, but they should be free of metal burrs that may become dislodged during the make-up of threads. Burrs detected on a chamfer during inspection may be removed by filing, or rejected. Minor cuts or mashes on a chamfer, which do not affect the threads, are not rejected provided that the end of the pipe complied with other API Specifications. Occasionally, a false starting thread is observed on the chamfer of the pipe. This is a premature cut on the chamfer and is not part of the starting pipe.

13.4.1.4 Recess

The inside diameter of the recess at each end of the coupling should have a sufficient surface for cutting.

13.4.2 Thread Length

A. 4 - Total thread length: From the end of pipe to point of the thread (8 round).The L4 dimension is measured parallel to the thread axis from the beginning of the thread (end of pipe) to the vanish point of the thread tool mark. The measurement is made using a metal scale with 1/32" divisions.

The total length is acceptable if L4 is within the specified tolerances + one thread turn on 8 round threads.

B. A1 is the distance from the end of the (buttress) pin to the base of the triangle stamp. A1 is measured in a manner similar to the L4 length for round thread casing. The tolerance for A1 dimension is + 1/32".
** (There is no tolerance given in STD 5B). **

C. NL- Minimum length of a coupling. NL is the coupling length and must equal or exceed the specified values provided in API 5A5. This measurement is performed by placing the steel rule longitudinally along the outside surface of the coupling.

Note: These steps of the visual inspection can be performed in conjunction with the inspection.

13.5 DIAL GAUGE INSPECTIONS

The documentation and procedure requirements to perform API thread inspections are outlined in the API Std. 5B and the API RP5B1 manuals.

13.5.1 Thread Height

Thread height (depth) is the measurement of the distance from the thread root to the thread crest normal to the thread axis.

13.5.1.1 Tolerances

A. Eight (8) Round- Eight (8) round height is .0710", and must range between .067" to .073" in (+.002" /- .004") thread range height.

B. Buttress- Buttress thread height is .062", and must range between .061" to .063" in height. (+/-.001")

13.5.1.2 Gauges

A. 8-rd- There are several types of thread heights gauges which are used for inspecting round threads. External-internal gauge and internal gauge for 3" OD and smaller are used. Two types of dial Indicators are provided on the gauges:

1. Balanced dial type

2. Continuous reading type

All round thread gauges are equipped with contact points having an included angle of 50 degrees.

B. Buttress Threads- Two styles of thread height gauges are used for buttress threads:

1. Straight anvil type external\internal height gauge (buttress pin and coupling threads 13-3/8" OD and smaller);

2. Step anvil type, external-internal height gauge; (buttress pin/coupling threads of 16", 18-5/8" and 20" diameter)

The accuracy of each type of gauge is verified by setting standards. The setting standards for the height gauge on 13-3/8" OD and smaller buttress threads are similar to the standard applications for round and line pipe threads. A step type standard is used for the height gauge associated with 16", 18-5/8" and 20" buttress casing. The steps provide correct positioning of the contact within the thread for a correct reading.

13.5.1.3 Procedure

The proper application of the gauge to the product is performed by placing the contact point of the thread height gauge in the thread groove. The anvil must be held in firm contact with the thread crest. The gauge must be aligned with the axis of the pipe. This is properly accomplished by rocking the gauge about the longitudinal axis of the anvil. The reading obtained is correct when the dial indicator stops moving near the center of the rocking motion, the null point. This procedure is performed on the first and last full crested thread within the perfect thread length.

Note: It is most important to obtain proper thread height when trying to determine the actual pitch diameter of a connection.

13.5.2 Coating Thickness

The threads in casing and tubing couplings are either electroplated, heat treated, or processed by other acceptable methods which minimize galling and create maximum leak resistance characteristics of the connection.

Excessive tin or zinc coating thickness can affect the readings of various thread gauges. Knowing the coating thickness can assist the inspector in determining whether a coupling should be accepted or rejected. (The maximum thickness of electroplated tin coating shall not exceed .006".)

Coating thickness is easily verified during the thread height inspection of the coupling. When a customer requests a more accurate inspection of coating, Technical Industries, Inc. provides a digital dry film micrometer that is proven to be most accurate.

13.5.3 Lead

Lead is the distance from the point on a thread turn to a corresponding point on the next thread turn, measured parallel to the thread axis. Lead measurement is taken in the perfect thread area on all API connections. (The perfect thread length is listed in API 5B.) If lead is "slow", there are too few threads per inch. If lead is "fast", there are too many threads per inch.

13.5.3.1 Lead Tolerances

There are two (2) lead tolerances to be concerned with:

A. A per inch tolerances

B. A cumulative tolerance

Eight (8) round lead is measured within the perfect thread area. The permissible limits are + .003" per inch and + .006" cumulative error (within L4-g).

Buttress lead (13-3/8" and smaller) is measured within L7. The permissible limits are + .002" per inch and + .004" cumulative error.

Buttress leads (16" and larger) is measured within L7. The permissible limits are + .003" per inch and + .004" cumulative error.

13.5.3.2 Lead Gauges

There are two (2) types of dial gauges available for measuring lead tolerance, each being equipped with two contact points and balance dial indicator:

A. External/internal (4-1/2" OD and larger) type

B. Internal (less than 4-1/2" OD) type

The lead gauge shall register zero when applied to the setting standard. Adjustment is necessary if the gauge does not register zero. This adjustment is performed while the lead gauge is applied to the setting standard.

When gauging buttress, pressure must be applied against the gauge so the thread contact points are in contact with the load flank.

13.5.3.3 Lead Gauging Procedure

The fixed gauge point is placed on the line in the first full thread groove near the small diameter of the thread. With the movable point in the thread groove at the first interval marked, the gauge shall be pivoted in a circular arc about the fixed point on either side of the longitudinal line. The maximum or minimum reading along the longitudinal line represents the error in lead. (Overlapping interval might be needed depending upon the length of perfect threads.)

Eight round cumulative lead is measured over the L4-g length, starting with the first full crested thread from the end of the pipe. Only perfect threads may be included in the cumulative lead measurement. Perfect threads are established same as for the thread height.

Cumulative lead is the lead measured starting with the first perfect thread over an interval (in excess of 1") which is the largest multiple of 1". The gauge is applied to the product as provided above for per inch measurement, except the cumulative lead length may include black crested threads, if the black crested threads have at least 0.035" depth. No cumulative lead measure is necessary if the black crested threads do not have a minimum of 0.035".

13.5.4 Thread Run-out (Buttress Only)

Thread run-out is the measurement of the abruptness with which the buttress thread is terminated at the triangle end of the thread. A rapid pull-out of the cutting tool results in steep slope at the end of the thread. This causes high stress at the contact point when the coupling is made up.

13.5.4.1 Gauge

The run-out gauge is a three (3) point gauge having two (2) fixed points and one (1) movable point attached to a balanced dial indicator. Accuracy of the gauge is verified by zeroing the dial indicator on a flat surface.

13.5.4.2 Procedure

Two (2) possible thread run-out conditions can occur:

A. Before the base of the triangle

B. Within or beyond' the apex of the triangle

If the thread terminates before the base of the triangle, the movable pointer is placed in the last thread groove 90 degrees prior to the thread termination and the gauge rotated clockwise until the pointer exits the thread groove and rides on the pipe surface. If the thread terminates within the triangle, the movable pointer is placed in the thread groove 90 degrees prior to the thread termination or the apex of the triangle, whichever occurs first. The gauge is rotated clockwise until the point either exits the thread or passes the triangle apex.

If the thread terminates beyond the apex, the movable pointer is placed in the thread groove 90 degrees prior to the apex then the gauge is rotated clockwise until the pointer passes the triangle apex.

The run-out is satisfactory if the dial indicator does not exceed + .005" during the traverse of the thread groove. A dial indicator reading in excess of +.005" is not acceptable. All readings, including negative readings, +.005" and less are acceptable.

Contact points for the run-out gauge shall be 0.057" diameter ballpoints. For 16" and larger buttress casing the run-out gauge shall be set up and zeroed using the perfect thread roots as a setting standard. These perfect thread roots shall be checked for proper taper prior to setting up the run-out gauge.

13.5.5 Taper

Eight (8) round taper is defined as the increase in the pitch diameter of the thread, in inches per foot of the thread.

Buttress thread taper is defined as a change of external thread diameter along the pipe and along the internal thread cone. This change in the thread taper can be measured per inch and per foot.

13.5.5.1 Tolerances

A. Eight (8) round tolerances are: + .0625"/ft. -.0312"/ft. within the perfect thread area.

B. Buttress taper tolerances are: +.042"/ft.-.018"/ft. within the perfect thread area. (Within the imperfect thread tolerances area are +.054"/ft. -.018"/ft.)

The taper and taper tolerance(s) are listed in Std. 5B in feet: however, the inspector must work in inches; therefore, to convert these specifications one must divide by 12 to get the per foot tolerance(s).

13.5.5.2 Taper Gauges

Three (3) different gauges are available for inspection of thread taper:

A. External - Thread taper caliper

B. Internal - Thread taper gauge for threads on 4-1/2" OD and larger

C. Internal - Thread taper gauge for threads on pipe less than 4-1/2" OD.

These particular gauges are provided with a continuous dial type indicator. The gauge contact points must comply with the type of thread being inspected.

A. Eight (8) round contact points: .072"

B. Buttress contact points: .090" in diameter.

Taper gauges are adjusted on the pipe to be inspected. The threads must be provided with a longitudinal line divided into 1" (1/2") intervals. The caliper is adjusted (zeroed) by placing the fixed contact point on the longitudinal line in the groove past the first full crested thread. The movable contact point shall be placed in the same groove diametrically opposite the fixed contact point. The fixed point shall be held firmly within the thread groove while the movable point is oscillated through an arc within the groove. The dial pointer shall indicate zero at the maximum reading. The dial indicator should be adjusted if the reading is not zero.

13.5.5.3 Eight (8) Round Taper Procedure

External-The external taper gauge is applied in the same fashion as during adjustment. The gauge is applied at 1" intervals from the small toward the large diameter of the thread.

Eight (8) round external taper is measured over the L4-g length (i.e. - perfect thread length). When the last interval of measurement is less than 1", the gauge is placed in the last full thread groove.

Internal-When determining eight (8) round internal taper, the gauge is adjusted on the coupling. The coupling threads must be provided with a longitudinal line divided into 1" intervals. For inspection purposes, the coupling full crested thread length extends from the first perfect thread (third thread root from end of recess) to the J + 1 thread length (fifth thread and sixth thread from coupling center for 8 round and 10 round).

The internal taper gauge shall be inserted into the coupling so the movable contact point is at the top of the coupling and the fixed contact point is at the bottom of the coupling. The gauge is adjusted by placing the fixed contact point on the longitudinal line in a thread

groove five (5) threads from the center of the coupling for 8 round. The movable point is placed in the same groove 180 degrees opposite from the fixed point. The dial indicator shall be at zero at the null point as the movable point is moved through a small transverse arch.

The taper is measured by taking successive readings at 1" intervals moving toward opening near the coupling.

13.5.5.4 Buttress Taper Procedure

The procedure discussed in the "Round Thread" section should be followed. Taper is inspected over the thread length as discussed in the "Buttress Thread Cumulative Lead" section.

External-Unlike other threads, two areas of the buttress threads must be inspected; the perfect threads and the imperfect threads. The taper of perfect threads (no black crested threads) is inspected at 1" intervals, overlapping as necessary to inspect the entire length. A similar procedure is applied to the imperfect threads.

Tapers and corresponding tolerances are different for the perfect and imperfect threads and for 13-3/8" OD and smaller pipe and 16" OD and larger pipe.

Internal-The gauge is adjusted on the coupling. The procedure discussed in the "Round Thread" section shall be applied. The length L4 + .5" thread pitch from the face of the coupling shall be inspected at 1" intervals.

The taper gauge is applied to the product in the same fashion as gauge adjustment. The round thread inspection procedure is followed. The interval thread inspection starts at the first perfect thread (first root from the open end of couplings having full crested threads on both sides) and proceeds to the L4 + 1/2 thread pitch.

The buttress thread coupling shall contain only perfect threads in the interval L4 + 1/2 pitch to the coupling end. Accordingly, only perfect thread taper and tolerance is determined. However, different taper tolerances apply to 13-3/8" OD and smaller couplings than apply to 16" OD and larger couplings.

13.5.6 Pitch Diameter & Out of Round/Ovality

Stand-off- The distance measured axially specified reference points.

Pitch diameter- The diameter of the pitch between the size of a API connection at E1 or L1 as in API Std. 5B.

13.5.6.1 Relating Pitch Diameter to Stand-off

The measurement of "stand-off" on threaded connections is a method indicating pitch diameter. This method does not allow for ovality of the connection which can yield an

incorrect reading of "stand-off". All elliptical connection can check o.k. on tolerance and yet the oval condition has pitch diameter below acceptable specifications.

By taking readings about several axes, the ovality can be averaged out to "effective" pitch diameter.

13.5.6.2 Pitch Diameter Gauge

Pitch diameter and ovality is determined by the use of an MRP gauge.

All setting standards are manufactured traceable to the National Institute of Science and Technology. The setting standards are calculated and manufactured strictly to adhere to the data provided in API standard 5B. This data provides the required pitch diameter at the "plane of hand-tight engagement" for all API connections.

The first pipe is used to set the pitch diameter gauges to the proper length from the end of the pipe to the plane of pitch diameter and to the proper pitch diameter. (Axial setting standards and pitch diameter setting standards are applied for gauge calibration.)

The gauge is positioned over the end of the threaded product with bearing pads positioned against the end of the pipe. Using the lower contact shoe as a pivot point, the gauge is pivoted across the thread crest until the indicator changes direction.

The highest and lowest indicator readings are determined for averaging pitch diameter as well as documentation purposes. Ovality is measured at the same time.

Ovality and/or out of round can be determined by rotating the MRP gauge about the axis of the pipe and positioning shoes at various points about the circumference.

13.5.6.3 Field Tolerances

The tolerances listed below are used for inspection purposes: *(unless otherwise specified by the customer)*

8 Round 3/4 TPF

Pin + .015

Box + .015

Buttress 3/4 TPF

Pin - .010/+ .006

Box - .010/+ .012

Buttress 1" TPF

Pin - .010/+ .008

Box -.010/+.012

13.5.7 Power-Tight Make-up

Although the tolerance for 8 round is not API specified, it is provided as a guideline for determining power-tight make-up. (Provided in API R5A5).

Determine the coupling length (N), divide by 2, and J area (N/2+J). This is the nominal position of the end of pin in coupling. Measure the distance from the face of the coupling to the end of pin inside the coupling. If the measured distance is different from the nominal distance by more than three (3) thread turns (+ .375") the condition is reported to the customer.

The same procedure for 8 round applies to buttress for determining nominal make-up (N/2 + J). For back up verification the inspector can reference the end of the couplings to the triangle stamp. When using a metal scale, the inspector marks his nominal make-up position and the stand-off/stand-in positions. The face of the coupling should be located within one (1) thread turn from the base of the triangle and no further than the apex of the triangle. If the coupling is not made-up to the proper position on the triangle stamp, it is reported to the customer.

13.6 POST INSPECTION

13.6.1 Markings

Listed below are marking(s) which inspected material and Technical Industries, Inc. reporting provides identification of:

A. Acceptable material is stenciled in white and the following information is indicated:

1. Pipe size, weight, grade & type of thread;
2. Type of inspection performed;
3. Technical Industries, Inc. job number;
4. Date of inspection;
5. Unit and/or inspector
6. Customer name / PO #

B. Rejected material is identified by red paint bands around the OD of a bad coupling, or around the pipe OD beyond the last pin thread of a rejected pin connection.

C. When measurement rejects a coupling, the type, value and location of the measurement is noted on the OD of the coupling with a metal marker.

D. When a measurement rejects a pin thread, the type, value and location of the measurement is noted on the pipe OD near the last pin thread and in line with the measurement.

E. The identification requirements of (C) and (D) are noted on a Reject Sheet report form that is provided to the customer by Technical Industries, Inc.

13·6.2 Reporting

Inspection Reports, together with the Reject Sheets, are provided to the customer with the following:

A. Customer's purchase order no.
B. Material description
C. Brief Summary of inspection performed
D. Number of lengths (rejected and/or accepted)
E. Location of defect and joint no.
F. Type of defect

REVISION HISTORY

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Complete Revision History	--

SECTION 14 - PORTABLE FIELD HARDNESS TESTING

14.1 Scope

This procedure contains the minimum requirements used by Technical Industries, Inc. to perform field hardness testing of Oil Country Tubular Goods.

14.2 References

Technical Industries, Inc. hardness testing procedure is based on the requirements of ASTM E 18-07, API 5A5 and API 5CT.

14.3 Personnel

Personnel performing Hardness Testing shall be as a minimum a Level I Visual Inspector. All work shall at a minimum be supervised by a Level II Visual Inspector. All qualification levels shall be based on the latest edition of the Technical Industries, Inc. Training and Qualification manual.

14.4 Equipment

14.4.1 The hardness testing device normally used for field hardness testing is the Rockwell C-scale tester. Other types of hardness testers are available but are only used if a customer requests a specific type or in TI opinion the material to be tested would have readings that are better evaluated using a different type of tester.

14.4.2 The Rockwell tester used shall be equipped with a load cell that can exhibit an indention into the material that can be evaluated either by a comparison of depths achieved versus load applied or measurement of diameters of ball indentions and conversion by a scale or chart. The indention by a specific load and comparison is the preferred method used by Technical Industries, Inc.

14.4.3 The indenter for the HRC scale shall be a diamond speroconical type. Tungsten carbide ball indenters of specified diameter may be used for testing of thin materials (HRB).

14.4.4 Equipment used for testing shall be adhered to the material by use of a magnetic base or a chain assembly. A chain assembly is preferred for testing of couplings or when the material to be tested is shorter than the magnetic base of the tester.

14.5 Calibration

14.5.1 The instrument shall have a current calibration exhibited. The calibration authenticates that the linearity of the instrument has been validated to be acceptable by the manufactures specifications. Calibration shall be accomplished ever 12 months by a certifying agency. Verification of accuracy shall be done every 4 months. Verification procedure shall be as stated in the Sixth edition of 5A5.

14.5.2 Standardization shall be accomplished by use of a calibration block that has a specified value within the range of the specified hardness values of the material.

14.5.3 The test block can only be used on one side and shall have a valid certification.

14.5.4 A successful standardization shall be two consecutive readings on the test block that have a value within the tolerance specified for the test block.

14.5.5 Standardization shall occur at the start of the job, after every 100 tests (two or more valid readings made in the same area), whenever the tester is subjected to abnormal mechanical shock, at the end of the inspection job or whenever readings fall into question by the operator.

14.5.6 Standardization results shall be recorded on form F-8.4.5-21. All information on this form will be completed, i.e. serial # of tester.

14.6 Test Application

14.6.1 Test locations shall be prepared by removing material to create an area free from oxide scale, foreign matter and lubricants, appx. 0.010" of surface material, to create a flat area so that accurate readings can be obtained.

14.6.1.1 Wall thickness shall be verified by used of a thickness meter prior to removal of any material. Wall after removal must be greater than 87.5%.

14.6.1.2 Grinds shall be made as smooth as possible. Coarse grinding paper is not recommended.

14.6.2 The pipe shall be rigidly supported and blocked to prevent rolling.

14.6.3 Hardness test equipment shall be attached to the pipe in such a manner that the load application line is perpendicular to the test location.

14.6.4 It is recommended that major load be held for 3-5 seconds.

14.6.5 Test locations shall be as follows unless specified differently by the customer or customer representative.

14.6.5.1 Integral joint tests shall be on each upset and in the center of the joint.

14.6.5.2 Threaded and coupled tests shall be appx. one foot from each end of the joint and in the center of the coupling.

14.6.5.3 Loose couplings shall be tested on the OD and in the center of the coupling.

14.6.6 Two readings at minimum shall be taken at each test location and averaged, if within two HRC numbers and 4 HRB numbers the readings are valid test. If they differ by more than two

numbers or 4 numbers on the HRB scale than additional readings must be taken. Indentions should not be made any closer to each other than 2 ½ times the diameter of the indentation from the edge of the test area and shall not be any closer than 3 times the diameter of the indentation. Measurements shall be made from the center of the indentation. Readings shall be written in metal marker next to the test area.

14.6.7 All readings are to be recorded on a hardness testing form, F-8.4.5-20, by the operator. Final determination on not acceptable reading results shall be made by a Level II. Any single piece that has test areas differing by 4 numbers shall be referred to the Level II for evaluation.

14.7 Reporting & Marking

14.7.1 All test areas are required to have a recorded reading on the Hardness Report Sheet, F-8.4.5-20.

14.7.2 All joints that are out of hardness acceptable range must be recorded on the Reject Sheet, F-8.2.4-7 for that work order.

14.7.2 All joints not accepted in the hardness test range shall be identified by red paint if the hardness values do not meet the acceptable range listed in 5CT. If values are not listed in 5CT the customer must supply or approve the accepted range. Technical Industries, Inc. will use the manufactures specification when none are given. Material not accepted in this category shall be banded as specified by the customer.

REVISION HISTORY

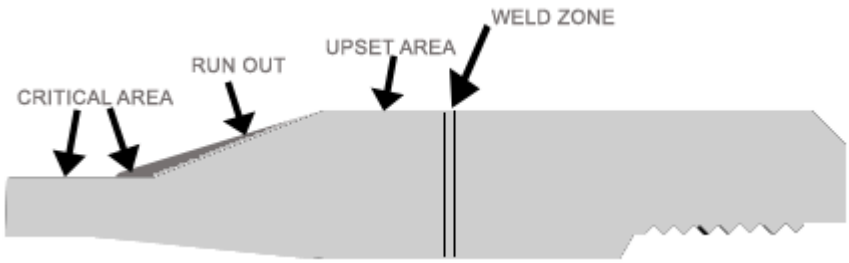
REV.	Description of change	Effective Date
New	Added this section	7-2-2008
--	See Table of Contents for Complete Revision History	--

SECTION 15
ULTRASONIC INSPECTION OF DRILL PIPE UPSETS, WELDS & CRITICAL AREA

15.1 Scope

The procedure covers the bi-directional (Longitudinal & Transverse orientations) ultrasonic inspection of drill pipe upsets, tool joint to tube welds and critical end area of new and used drill pipe. The technique shall be the contact method.

The application of this method is to detect discontinuities that may or may not be open to the surface of the material being tested.



15.2 Reference Documents

The following documents latest edition, are used by Technical Industries, Inc. as a basis for establishing this procedure.

15.2.1 ASTM E213 Standard Practice for Ultrasonic Examination of Metal Pipe and Tubing.

15.2.2 ASTM E587 Standard Practice for Ultrasonic Angle Beam Examination by the Contact Method.

15.2.3 ASTM E317 Practice for Evaluating Performance Characteristics of Ultrasonic Pulse Echo Testing Systems without the Use of Electronic Measurement Instruments.

15.2.4 API Specification 7 Rotary Drill Stem Elements

15.2.5 API Specification 5D Drill Pipe

15.2.6 API RP7G Drill Stem Design and Operating Limits.

15.3 Personnel Qualifications

Personnel performing Ultrasonic Inspection of Drill Pipe Upsets, Welds & Critical Area should as a minimum be a Level II in Ultrasonic. The Level II personnel qualification is based upon the latest edition of the Training and Qualification Manual of Technical Industries, Inc. The program meets all of the requirements of ASNT SNT-TC-1A.

15.4 Equipment

15.4.1. The instrument shall be of the pulse echo type with an A-Scan presentation. A digital instrument with a freeze frame option and a calibration storage is preferred. It shall be equipped with a light display and audible alarm. The instrument shall be capable of generating, receiving and amplifying high frequency electrical pulses at a rate to perform a meaningful examination.

15.4.2 Calibration of the equipment for horizontal and vertical linearity should be accomplished every 6 months and be indicated by placement of a sticker showing the date of calibration, the due date for calibration and signature of the person who performed the calibration.

15.4.3 The ultrasonic transducer shall be capable of transmitting and receiving at the required frequencies in the material to detect discontinuities. The Megahertz shall be 2.25 with a ½" square surface area. The transducers shall be mounted on a plastic wedge that has a radius corresponding to the pipe diameter of the material to be inspected. It should be noted that for transverse oriented discontinuity scanning a flat wedge can be used but should not be bigger than the radius so that any rocking of the wedge is prohibited. Either orientation of wedge shall be capable of generating a 45º refracted angle in steel.

15.4.4 The couplant shall have a suitable viscosity in order to permit the transmission of the ultrasound from the transducer to the material being examined. Couplant shall be either water or cellulose gel. Oil or grease may be used but examination of the cork barrier for deterioration should be observed if this is used on any permanent basis.

15.5 Reference Standards

15.5.1 Weld Zone

The standard shall be manufactured from material with the same outside diameter and wall thickness as the product to be inspected. In addition the material

used shall be acoustically similar in velocity and attenuation to the material to be inspected. The standard shall contain a 1/16" diameter through drilled hole as specified in API Spec 7.

15.5.2 Upsets & critical area
The reference standard shall be made from a sound section of drill pipe with the same outside diameter, wall thickness and grade as the pipe to be inspected. The standard shall contain both ID and OD notches, longitudinal and transverse. The notches shall be 5% in depth based upon the specified wall thickness for all new Group 3 drill pipe. For Group 1 pipe and all used drill pipe the notches shall be 10% of the specified wall thickness. All notches shall be a maximum 1" long and .040" wide.

15.5.3 All notches will be certified by the manufacture and shall be permanently marked with the serial number, material description, and grade.

15.6 Standardization

15.6.1 Choose a reference standard that is of the same description as the material to be inspected. A weld standard should be utilized for standardization when inspecting the weld zone. A Upset and critical area standard shall be utilized for standardization when inspecting the upset and critical area. If an upset and critical area standard is not available the standard being used for the tube inspection can be utilized as long as the reference notches meet the criteria listed above.

15.6.2 Transverse Inspection Standardization

15.6.2.1 Standardize the transducer on the transverse ID notch on the critical end area inspection reference standard.

15.6.2.2 Check from both sides of the notch and adjust the weakness signal to 80% Full Screen Height (FSH).

15.6.2.3 Record the gain settings and location of the ID notch signal along the horizontal baseline of the A-scan display using form F-8.2.4-9.

15.6.2.4 Repeat the above process for on the transverse OD notch. Record the gain settings and location on the horizontal baseline of the A-scan display using form F-8.2.4-9.

15.6.2.5 Standardize the transducer on the bottom of the through drilled hole on the internal surface. Scan from the two sides if possible and adjust the weakest indication to 80% FSH on the A-scan display.

15.6.2.6 Record the gain setting, and location of the internal surface through drilled hole signal on the horizontal base line of the display using form F-8.2.4-9.

15.6.2.7 Repeat the above process for the external surface of the through drilled hole.

15.6.2.8 Insure the A scan display screen range is wide enough to display all of the above reflectors. Establish a horizontal gate at 60% FSH to encompass all of the reflectors.

15.6.3 Longitudinal Standardization

15.6.3.1 Standardize the transducer on the longitudinal ID notch for the upset and critical area inspection.

15.6.3.2 Scan the notch from both sides. Adjust the weakest signal to 80% FSH on the A-scan display.

15.6.3.3 Record the gain settings and location of ID notch signal along the horizontal baseline of the display using form F-8.2.4-9.

15.6.3.4 Repeat the above process on the longitudinal OD notch.

15.6.3.5 Standardize the longitudinal transducer on the internal surface of the through-drilled hole. Adjust the weakest signal to 80% FSH.

15.6.3.6 Record the gain settings and location of the internal surface signal of the through-drilled hole along the horizontal base line of the display using form F-8.2.4-9.

15.6.3.7 Repeat the above process on the external surface of the through drilled hole.

15.6.3.8 Insure the A scan display screen range is wide enough to display all of the above reflectors. Establish a horizontal gate at 60% FSH to encompass all of the reflectors.

15.6.4 After standardization is achieved, review the recorded gain settings from the notches and through drilled hole and adjust the gain setting to the lowest reference signal amplitude for scanning purposes. Scan all notches and through drilled hole to ensure the reflectors are detected above the 60% FSH. This will determine the scan speed.

15.6.5 Standardization should occur at the start of the job, and each start up if a multiple day process, a change in power source, after any malfunction, if the unit has been turned off and is turned back on, whenever the transducers or wedge's are changed, every 25 jts. or the last joint is inspected.

15.6.6 If standardization is verified and reveals a loss of signal amplitude from the reference notches or through drilled hole of more than 2 dB, all joints inspected since the last successful standardization shall be re-inspected.

15.7 Surface preparation

15.7.1 The surface area for inspection shall be clean and free from all dirt, thread dope, grease, rust, loose coatings, paint and other types of foreign materials that can limit the inspection process. Cleaning shall be achieved using steam cleaners, soapy water, varsol, grinders with buffing wheels, etc.

15.7.2 Each joint shall be sequentially numbered.

15.8 Inspection Technique

15.8.1 Apply a generous coating of couplant to the weld areas, upsets and critical area portion of the tube. The same couplant used for standardization shall be used for the inspection application.

15.8.2 At the scanning speed determined previously scan the weld, upset and critical area of the drill tube 360º insuring a minimum of 100% coverage. The area for inspection is from the tool joint taper, through the upset, external and internal taper area to an approximate point 4" from the internal taper run out.

15.8.3 The direction of scan shall be toward the tool joint taper for transverse inspection of the weld.

15.8.4 The direction of transverse scan for the upset and critical area shall be in both directions. From approximately 4" prior to taper run out, through the taper area, and the upset toward the weld area. The opposite direction shall be from the

weld, through the upset, through the taper area to an approximate point 4" beyond the taper run out.

15.8.5 The longitudinal scan shall cover the area from behind the tool joint taper to the point 4" beyond the taper run out. This area will be covered clockwise and counter clock wise.

15.8.6 During the inspection observe the ultrasonic instrument display for indications exceeding the gate, light display alarm and listen for the audible alarm to sound.

15.9 Evaluation of Indications

15.9.1 Indications detected during scanning shall be evaluated at calibration settings.

15.9.2 All indications that exceeded 60% FSH shall be considered relevant and evaluated.

15.9.3 Indications that do not exceed 60% FSH but are possible fatigue cracks shall be deemed relevant and investigated further. A high intensity light, borescope and MPI techniques shall be employed in the investigation.

15.9.4 All relevant indications located on the ID or OD surface of the material shall be reexamined with appropriate unit gain setting adjusted to the reference level established in section 15.6.

15.9.5 The settings determined for the transverse ID notch, and the longitudinal ID notch shall be utilized when evaluating internal indications in the upset, the critical end area and the upset taper portion of the drill tube.

15.9.6 All weld area indications shall be evaluated using the through drilled hole.

15.9.7 All non-weld area relevant mid wall indications shall be evaluated by establishing a distance amplitude curve (DAC).

15.10 Acceptance Criteria

15.10.1 All indications, which are determined to be fatigue cracks, shall be rejected.

15.10.2 All relevant indications which cannot be reached for mechanical measurement that exceed the distance amplitude curve (DAC) shall be rejected.

15.10.3 All indications that exceed the reference of the through drilled hole located in the weld zone shall be rejected.

15.10.3 All relevant indications, other than cracks, located in the upset area and exceed the reference notch level shall be evaluated according to Table 10 in API 5D for new material. Used material that has an indication exceeding the 10% reference notch shall be rejected.

15.10.3 Indications exceeding the reference notch for the upset taper shall be rejected if it reduces the wall thickness to less than 87.5% of specified wall, Table 10 API 5D.

15.10.4 Indications exceeding the reference notches located in the critical area shall be rejected on used material. On new material it shall be rejected and set aside for manufacture evaluation.

15.10.5 All OD indications that are accepted shall be removed by grinding. They shall be contoured to the pipe radius and wall thickness verified as acceptable after removal has been accomplished.

15.11. Post Inspection

15.11.1 All excess couplant shall be removed.

15.12 Marking and Stenciling

15.12.1 All marking and stenciling shall be as per the Technical Industries, Inc. Work Order (F-7.5.1-1).

15.13 Reporting

15.13.1 All rejected material shall be listed on the Reject Attachment Report (F-8.2.4-7) giving location of defect and level of non-acceptance.

15.13.2 All material for the service will be listed on the Field Inspection Report (F-8.2.4-8) either as Prime or accepted material or reject or not accepted material.

REVISION HISTORY

REV.	Description of change	Effective Date
A	Initial Release	2006
--	See Table of Contents for Complete Revision History	--

Section 16: RECEIVING, STORAGE, SHIPMENT OF PIPE AND EQUIPMENT

16.1 Scope

This Work Instruction covers the handling of pipe and equipment products into Technical Industries, Inc. facility, their material control inventory system and subsequent shipment. The application of this work instruction will enhance the identification and traceability of the material in the system while physically handling the products without detriment to the material.

16.2 Referenced Documents

API RP 5A5 *Field Inspection of New Casing, Tubing and Plan End Drill Pipe*

API RP 5C1 *Recommend Practice for Care and Use of Casing and Tubing*

Technical Industries, Inc. Material Control and Inventory System.

16.3 Personnel Qualification

All personnel using OCTG handling equipment shall be qualified to operate the forklift they are assigned. All lift operators shall be tested on safety and operating knowledge on a regular interval. All lift operator new hire's shall be given a safety and operating knowledge test within the first 30 days of hire.

Technical Industries, Inc. uses an outside safety consultant to qualify the forklift operators.

The Technical Industries, Inc. inventory system should only have data input by a thoroughly trained input operator. Abilities shall be judged by the S&R Supervisor and the Software Engineer.

16.4 Equipment

All equipment assigned to the department will be kept in a well maintained status. Maintance will be performed at the prescribed intervals required by the maintance program.

No load bearing system of the lifts shall exhibit any fluid leaks or fatigue cracking, when being used to handle weighted material that might jeopardize the operator or the condition of the material being moved.

Equipment shall never be operated with a lifted weight that exceeds the recommended operating capacity of the lift.

16.5 Receiving Material

16.5.1 All inbound material shall be assigned a Work Order Number prior to the unloading of any vehicle. An authorization to accept the material into the yard from the assigned customer on the Work Order shall have been documented. The authorization should list the total footage, OD, weight per foot, grade, connection type, API range and quantity to be received as a minimum. The Work Order number assigned is a specific identification of the Technical Industries, Inc. inventory system that allows a history of activity to be generated while the material is in the possession of Technical Industries, Inc.

16.5.2 During offload of the material it shall be verified to be of the same description as listed on the Work Order and shall have the same number of pieces on the carrier as listed on the Bill of Lading.

16.5.3 All joints shall be identified by metal marker or stencil by the assigned Work Order number. In case of bundles, as many joints as possible shall be identified, count verified and marked. If material is in a crate the description of contents shall be verified but the crates shall not be opened prior to service for verification unless by customer request.

16.5.4 All material requiring special handling shall be identified prior to offload and the forklift shall be set up to facilitate the off-load. All CRA material shall be considered special handling. Padding of forks to prevent any metal to metal contact will be the standard for special handling. TI shall maintain a set of equipment that can be utilized to handle these special needs. All material will receive careful handling whether new, used or reconditioned.

16.5.5 When material is being accepted into the facility and into the inventory system the following shall be verified and made note of:

- Joint count
- Pipe Description
- Condition of thread protectors when applicable and number missing.
- General overall material condition.
- Any previous service stenciling.

Tallying of inbound material is not provided unless by customer request. At Technical Industries tallies are provided at point of service. If tally is requested QMS form F-7.5.3-1 Material Tally Sheet shall be used.

16.5.6 Upon verification of material with joint count by the yard crew the material quantities and any observed discrepancies shall be noted under the work order number assigned in the material control system. Input shall include date received, carrier information, total quantity and services to be performed or noted for storage only. A hard copy of the Work Order shall be issued on QMS form F-7.5.1-1.

16.5.7 Threaded material shall never be moved without appropriate thread protectors installed.

16.5.8 Upon completion of inventory input into the TI control program the Work Order will be either issued for services ordered or listed as Customer Storage. All hard copies of inbound paperwork will be placed in a Work Order specific file for records. All electronic activities generated by the services provided will be assigned to this specific work order e-file. Hard copies of the Work Order (F-7.5.1-1) will be generated as needed and placed in the assigned hard copy work order file.

16.5.9 Any additional charges that occur during offload, i.e. Overtime, shall be documented on the e-file Work Order and the hard copy. The additional charges shall be stipulated on QMS form F-7.2-2 and approved. This form shall become part of the e-file and the hard copy file.

16.6 Storage

16.6.1 Material received for storage or is in process for services will be stored on racks that are stable for the weight load. Pipe will not be placed directly on ground, rails, steel or concrete floors.

16.6.2 First tier of pipe will be no less than 18” from the ground to keep moisture and dirt away from pipe.

16.6.3 Pipe should rest on supports properly spaced to prevent bending of the pipe or damage to the threads. The stringers should lie in the same plane and be reasonably level and be supported by piers adequate to carry the full stack load without settling.

16.6.4 Wood strips shall be placed as separators between successive layers so that no weight rests on the couplings or end connections. .

16.6.5 Spacing strips shall be placed at right angles to pipe and directly above the lower strips and supports to prevent bending of pipe. It is recommended to use at least 3 spacing strips per layer.

16.6.6 Each layer of pipe shall have the WO number identification written on it with the number of joints specific to that row of pipe also written on the first visible joint of that layer.

16.6.7 Any rack that contains more than one Work Order number shall have a clear designation of where one work order ends and another commences.

16.6.8 At no time will material of different work orders be randomly mixed on a rack.

16.6.9 Each layer of material on a rack shall be blocked on the pier and spacing strips by either 1x2 or 2x2 blocks to prevent pipe movement. The blocks should be held firmly in place by nails, but care should be taken that the nails are not driven so as to make contact with the blocked material.

16.6.10 Pipe shall be racked so that all mill ends are in one direction and all field ends are in the opposite. Mixing of alignment is not permitted unless by customer request and the request must be documented.

16.6.11 All prime material should be racked separate from non-accepted material. The appropriate banding from the services rendered should note what is accepted and what is not. This report should become part of the electronic and hard copy file.

16.6.12 Pipe in storage should be inspected periodically and protective coatings applied when necessary to arrest corrosion. This should include all threads and exposed surface areas.

16.6.13 All material receiving service shall be noted on the material control inventory system. All classifications producing banding and joint quantities shall be recorded in the inventory program. All banding and joint counts shall be verified by a specified yard person.

16.6.14 All quantities receiving service and quantities not receiving service with the adjustment to original received quantities shall be reconciled and be equal prior to any shipments.

16.6.15 All pipe movements should be recorded for checks and balances as they are moved. This will ease the reconciliation of all total movements for service or shipment.

16.6.16 Quantity and description of the inventory being held is an ongoing verification. A complete physical inventory will be done on an annual basis.

16.6.17 Material in storage for a customer may be sold off or transferred to another customer. Such transactions must be recorded and approved. Transfer authorization shall occur, using QMS form 7.5.3-3 and shall become a part of the e-file and the hard copy file for both customers.

16.7 Shipment of Material

16.7.1 Prior to shipment of any material the physical inventory of that work order and the electronic quantities of that work order must match.

16.7.2 Before any material can be loaded onto a carrier, a material release must be on file with the S&R office. **Material can only be released by use of the Technical Industries, Inc. Transfer and Release of Inventory Approval form, F-7.5.3-3. The form must include all applicable signatures to be accepted.** No third party notification will be accepted unless it is an authorized representative of the customer.

16.7.3 A 24 hour notice of shipment should be requested from all customers in order to efficiently take care of their request.

16.7.4 All material during the load out operation will receive careful handling but if noted for special handling associated equipment will be used to facilitate the load out.

16.7.5 No threaded material will be moved without thread protectors in place.

16.7.6 Lift operators shall not jeopardize the material by attempting to load too many joints onto one lift load. Pipe during loading should be handled as a single layer on fork lift tines.

16.7.7 Pipe shall be loaded onto the carrier so as to distribute the weight equally on the axles of the carrier.

16.7.8 Load pipe with all mill ends in the same direction and all field ends in the same direction.

16.7.9 Pipe descriptions and quantities being loaded onto each carrier shall be verified against the release and submitted to the S&R office prior to release of the truck. The activities shall be assigned to a responsible person for physical attention.

16.7.10 Care should be taken that couplings or tool joints are not rubbed against each other during loading or final disposition on the truck.

16.7.11 Although not the responsibility of Technical Industries, any inadequate tie-down system on the carrier should be brought to the drivers' attention for correction.

16.7.12 The truck shall not be overloaded.

16.7.13 The truck with its load shall have the quantity and description verified prior to release from the yard. This information shall be listed on an S&R created Bill of Lading, QMS form F-7.2.2-5.

16.7.14 Pipe will receive an out bound tally recorded on QMS form F-7.5.3-1 to verify amount of footage being shipped and the piece count.

16.7.15 The inventory system shall be adjusted by each truck load of material that leaves the yard. This adjustment is for repair, or final shipment.

16.7.16 All customer generated requests shall be documented and become a part of the permanent file.

16.7.17 Any additional charges occurring during load out, i.e. Overtime, shall be documented on the e-file and hard copy file. QMS form 7.2.2-3 shall be completed for the approval of these charges. The form shall become a part of the e-file and the hard copy file.

16.7.18 Upon final activity in the Work Order and verification of all activities recorded in the e-file and the hard copy, the order shall be archived and kept for any future questions. The minimum time for storage should be 5 years.

Revision History

REV.	Description of change	Effective Date
New	Clause 16.7.2 authorization for shipment changed to **"Material can only be released by use of the Technical Industries, Inc. Transfer and Release of Inventory Approval form, F-7.5.3-3. The form must include all applicable signatures to be accepted"**	2-26-10
--	See Table of Contents for Complete Revision History	--

Section 17. FULL LENGTH DRILL PIPE INSPECTION for TRANSVERSE and WALL VARIATION FLAWS USING HALL ELEMENTS.

17.1 Scope

This work instruction details the "TECHSCOPE" computerized inspection unit used for locating imperfections and tube wear in the tube body of Used Drill Pipe. Detection utilizes transverse and wall inspection techniques in conjunction with other visual inspections. Full length visual and OD gauging for wear are included in this work instruction.
Critical area inspections are detailed in work instruction 16 and 18 using ultrasonic and magnetic particle inspection techniques respectively.
Tool joint inspections are covered in work instruction 19.

17.2 Referenced Document

API SPECIFICATION 7
API RP 7 G-2
ASTM E 570-97(2004)
TECHNICAL INDUSTRIES, INC. TRAINING & QUALIFICATION Program
TECHNICAL INDUSTRIES, INC. EQUIPMENT CALIBRATION Program

17.3 Personnel Qualification

All personnel performing work within this work instruction shall have a qualification level that has satisfied the requirements of Technical Industries Qualification and Training Program. All trainees will be supervised by a Level II.
Final material classification must be reviewed and accepted by a currently qualified Level II.
All personnel shall have passed the Visual Acuity and Color Contrast eye examination of the program.

17.4 Equipment

17.4.1 "TECHSCOPE" Full length flux leakage detection.

17.4.1.1 The "TECHSCOPE" unit utilizes Hall Element detection equipment. A detection head specially designed for the size of pipe being inspected encircles the tube being inspected; a magnetic field is applied and the variation in magnetic flux is measured and analyzed for wall variations and other non-conformities created by the use of the tube during drilling application. The analysis is conducted by our computer and software package which have controllable variations of data that is tops in the industry.

17.4.1.2 The inspection head is propelled from one end of the tube body to the next by a drive unit that utilizes two DC motors. The speed of the drive unit is adjustable on a scale of 1 to 10.
There are two types of detection devices in each inspection head. There are a specific set of high resolution solid state sensors mounted in each full contact shoe. There are 8 shoes in each inspection head. Shoe size and amount of sensors are relevant to the circumference of the tube.
The second detection device is eight non-contact wall loss sensors mounted on the inspection head.

17.4.1.3 A magnetizing coil comprised of aluminum wire windings encircles the drive unit and is designed to set directly over the top of the inspection head detecting elements.
The coil has an output to generate the required level of magnetic flux to register the required indications and wall loss detection required when standardizing the equipment for inspection.
Coil output flux is controlled by computer settings and the power supply. Coil size is determined by the size of the inspection head and the OD of the material to be inspected. There are 3 size coils.

17.4.1.4 Signal processing from the above referenced integrated components is control by the computer software. Various computer control screens (menus, buttons, switches, input boxes, text messages, graphs, etc.) display the controls for the operator to maximize his set ups and the inspection parameters.
Signal response is adjusted per detector shoe prior to adjustment on the master gain to establish the desired thresholds for inspection. This adjustment allows compensation for any loss of sensitivity in the single detection shoe when compared to the others in the configuration. These thresholds levels of the shoes can then be increased by the master gain (control of all the shoe signals) to the desired level for calibration and inspection.
Screen display has a 4 strip chart rendering to view as the inspection head is moved the length of the joint.
The charts display in real time the suspected Transverse Flaws, suspected localized wall loss areas abrupt in shape, suspected localized wall loss areas which are more gradual in shape and the Full Length Wall which displays suspected longitudinal Wall Loss areas detected by the sensors.

Equipment calibration and set up for inspection will be discussed further on in this procedure.
17.4.1.5 A set of air powered jacks are used to elevate the drill pipe tube above the racks for a complete passage of the inspection head from end to end without having to become uncoupled.

17.4.2 Reference Standards

17.4.2.1 Reference standards for TECHSCOPE flux leakage transverse flaws detection shall be through wall drill hole prepared from a length of pipe of the same nominal diameter as the pipe to be inspected. The drill hole size is 1/16" in diameter. The standard may have one hole for each detector.
An alternative to this type of standard may be used upon request of the customer or the decision of the TECHSCOPE operator. This standard is a piece of pipe with the same nominal OD but also with the same specified wall and of the same grade or higher as the material to be inspected. A thru wall drilled hole may be used or a 5% of specified wall transverse notch. The notch can be either on the ID, OD or both. They shall be separated in distance enough to produce two distinct indications from the same transverse detection shoe.

17.4.2.2 The Reference standard for the wall variation verification and set up will be part of the flux leakage standard. The area of reference shall either be an area of wall reduction machined into the standard or verification by manual thickness measurement of a specified circumferential ring of the standard. There should be a reference point of min. and max. wall reading points and the average of all readings in the ring.

17.4.3 Additional Required Inspection Equipment.

17.4.3.1 OD Gages are used to determine the amount of abrasive wear that has occurred to the pipe. All gages shall have a way of verifying dimensional set up. Either by a calibrated length bar 1/32" shorter than specified diameter or a calibrated dial caliper with ID precision jaws.

17.4.3.2 Ultrasonic Thickness gauge that has been calibrated for sensitivity verification with 1/32" FBH at least 3/8" from the front surface of a parallel surface reference block.
The gauge shall be capable of reading the thickness of a parallel surface test area within .001"of the actual thickness. Actual thickness shall be verified by a micrometer.

17.4.3.3 Hand yokes can be either AC or DC. DC is preferred. Either shall meet the calibration requirements of the Technical Industries, Inc. calibration program.

17.4.3.4 Depth gauges, Dial Calipers, Micrometers, Pi Tapes shall be available for use as needed.

17.4.4 All equipment that have movable and controllable detection or evaluation settings shall be calibrated and calibrated at the frequency as stated in the latest edition of the Technical Industries, Inc. Calibration Manual.

17.5 Surface Preparation

All surfaces for inspection shall be clean of all foreign material, i.e. Drilling mud, rubbers, prior to inspection. Sensitivity from a surface other than steel decreases the detect ability of flux leakage equipment and prevents accurate measurement of wear determined by the OD gage inspection.

17.6 Inspection of Drill Pipe Tube

17.6.1 A full length visual inspection shall be made to locate three dimensional imperfections, i.e. pits, gouges, dents, crushing, necking, string shot, bent pipe and any other visual imperfections.

17.6.1.1 The OD Visual Inspection can be done in conjunction with the OD gauging inspection or separate and cover from upset to upset.

17.6.1.2 A full length visual of the ID shall be done to locate pits, erosion and wire line cuts. An evaluation of the condition of the internal coating, if present, shall be made. An illuminating light shall be used to aid in the determination of these imperfections and conditions. Coating status shall be evaluated as a percentage of missing. Coating status does not classify the material.

17.6.1.3 All imperfections located shall be marked and evaluated to allow easy correlation when they are detected by the TECHSCOPE equipment. All imperfections located that would affect the classification of the material shall be marked and evaluated.

17.6.1.4 Pipe found to be bent or bowed with a 3.0” deviation over the entire length should not receive further full body inspections until they are straightened.

17.6.1.5 Pipe with a ½” (.500”) deviation in the first 5’ of either end should not receive further full body inspections until they are straightened.

17.6.2 OD Gauging

17.6.2.1 The length from upset to upset is gauged with the proper size of OD gauge to identify diameter reductions or expansions. For each 5' of pipe inspected a 360° roll of the pipe should occur while stabbing/dragging the gauge onto the pipe.
17.6.2.2 The OD gauge is a go-no go gauge that is set at 1/32" smaller than the specified outside pipe diameter. This dimension is set by use of a gauge bar. The bar should show a current calibration representing that it is the stated length within ± .005".
17.6.2.3 Prior to setting the gauge for measurement the two gauge faces should be check to ensure they are parallel. The bar should be placed at least 3 places across the gauge face to be sure they are parallel. The bar should be tight but not binding.
17.6.2.4 With the faces adjusted properly place the gauge bar between the plunger and lower face. The indicator needle should be pointing to 1. If it is not, bend until the needle is on one. It is now set to 1/32" under the OD of the pipe. If the gauge goes over the pipe it will indicator the amount of wear on the OD, i.e. 1/32", 2/32", etc. The standardization of the gauge should be checked every 25 lengths, if a mechanical shock occurs to the gauge, job breaks or at the end of the job.
17.6.2.5 The pipe should rotate at a min. of 10 times during the gauging of the joint. When the gauge goes over the outside diameter the anvil opposite the plunger should be held firmly against the pipe prior to reading. The pipe should be rotated 180° searching for the maximum reading. Mark the location of both faces when the maximum reading is attained. Determine whether the reduction is stress induced or wear.
17.6.2.6 Diameter reductions determined to be wear will be evaluated based on remaining wall determined by use of an Ultrasonic Thickness Gauge. Remaining wall value classification will be based on customer requirement or the drill pipe/workstring classification table in RP 7 G.
Note: This area may not be the lowest area of cross section average. The unit inspection may find other areas that have lower wall values. These areas will classify the joint if the cross sectional average is lower.

17.6.2.7 Stress induced reductions or increases have additional classification criteria than remaining wall. A diameter reduction without a wall loss is indicative of a stress induced reduction. Stretching will normally show displacement of wall thickness, but not proportionally.
The area of diameter increase or decrease should be evaluated using a caliper to determine the area of lowest or highest point. A machinist ruler should be used to determine the dimension and that dimension recorded. This diameter dimension will classify the material according to the diameter increase of decrease specified in the classification tables of RP 7G. The

diameter increase or decrease is expressed as a Percentage of the specified Diameter.

17.6.3 Hall Element Electromagnetic Buggy Inspection.

17.6.3.1 The drill pipe tube from upset to upset shall be inspected with the use of the previously described TECHSCOPE inspection equipment for detection of transverse oriented flaws that exceed the reference level established during standardization and both generalized and localized wall loss.

17.6.3.2 Calibration. All meters shall be calibrated in accordance with the Technical Industries, Inc. calibration program. All reference standards shall be authenticated prior to use and shall be the same size OD as the material to be inspected. Coils shall be calibrated in accord with the calibration program.

17.6.3.3 The computer system shall have the appropriate job information entered and shall be in calibrate mode for the equipment set up on the selected reference standard. The inspection head shall be of the same size as the pipe to be inspected. The calibration process is standardization of the entire detection system with equipment in place and activated. Any repair or part replacement that affects the detection shall be cause for re-calibration. Setting to achieve the greatest sensitivity shall be guided by the operating manual for the inspection system. All system controls shall be as guided by the operating manual.

17.6.3.4 Static standardization of the solid state sensors for transverse flaws shall consist of adjustment of signal amplitude on each sensor pack to set an establish threshold level. This is achieved by passing the sensor array over the reference joint while increasing or decreasing the computer control sensitivity to a desirable level so that all eight sensor array's signals are within peak amplitude of each other. A 20% variation from max signal to weakness signal is acceptable.

17.6.3.5 Once all of the solid state sensors are adjusted to the level required in 17.6.3.4 the master gain which controls all of the established response levels shall be adjusted to a threshold level that demonstrates good definition of signal from back ground noise. Signal amplitude shall be adjusted to be greater or equal to 25% of full scale. The signal to nose ratio shall be no less than 3 to 1.

17.6.3.6 A dynamic calibration shall be performed by movement of the buggy detection head over the full length of the test joint. Any signal response shall be clearly defined and separated from other reference signals. Each response shall be labeled as to what sensor head produced the response.

17.6.3.7 Wall loss monitoring is produced on three channels of the chart display. Two of the channels display localized wall loss both abrupt and

gradual, i.e. pits and formation wear. The third channel is a display of suspected longitudinal wall loss areas, i.e. rod wear.

17.6.3.8 All wall detection sensors shall be passed over the area of wall reduction on the reference standard and shall produce a full defined signal that is discernible from the wall graph display. The wall variation of the area of wall reduction shall of been checked with an ultrasonic thickness gauge and the readings recorded. The graph display shall demonstrate a wall variation that is indicative of the actual drop.

17.6.3.9 All final calibrations shall be done dynamically and stored in the computer storage file for this job. The file shall be referenced for signal variation on all subsequent calibrations. Any signal loss greater than 20% of the original signal, the detection system shall be re-calibrated.

17.6.3.10 Calibration intervals shall be at the start of the job or shift, every 50 jts, any power interruption, prior to equipment shutdown, after repair or part replacement, whenever any settings are adjusted and prior to the end of the job.

17.6.3.11 After calibration the detection system shall be put into inspection mode for the job detail previously entered. All calibration settings shall be saved and these parameter settings shall be used for inspection of the pipe.

17.6.3.12 The traveling head shall be bumped against the tool joints on both ends with the detector side leading. The inspection head when placed on the pipe shall be facing the tool joint at a distance approximately 3'. After the coil in placed on the head and energized the detection assembly is propelled into the tool joint until it is stopped. Turn the detection assembly around, activate equipment and inspect toward the far tool joint until the assembly is stopped by the tool joint.

17.6.3.13 The threshold established during calibration of the equipment shall be used as the point where signals that exceed or equal the threshold settings shall be marked on the chart and also on the pipe for further evaluation by an accepted hand prove up method. Markings shall indicate type of flaw to be investigated, i.e. flaw, wall.

17.6.3.14 All inspection runs are part of the permanent record of the job and shall be saved on the computer system for later download to a storage device. The inspection pass shall identify the current date and time of inspection. Each inspection pass shall be identified with a joint number that corresponds to the joint number applied to the material.

17.6.3.15 The unit On Board Diagnostic system shall be full activated and functioning during all inspection passes. If the system signals a problem the component causing the issue shall be identified and repaired or replaced. The inspection data gathered during the problem inspection pass is not accepted and the joint shall be re-inspected and the new finding saved as the new joint number.

17.7 Evaluation and Classification

17.7.1 All indications that are marked for prove up shall be evaluated by visual, magnetic particle and ultrasonic methods. For each indication the prove up area shall be the width of the inspection head, approximate 4", on each side of the marked area and 90 degrees in circumference both sides of the mark.

17.7.2 All indications shall be evaluated against customer requirements or the latest edition or API RP 7 G, whichever is specified on the Job Work Order.

17.7.3 Areas of concerned shall be evaluated first on the OD by a visual inspection of the area for possible imperfections. A magnetic particle inspection shall be performed in the area. Any imperfections located from these methods shall be measured and the depth recorded. An ultrasonic thickness measurement shall be taken on the 2 sides of the imperfection and averaged. The deepest depth of the flaw and the subsequent Remaining Body Wall calculation shall determine the final value for classification.

17.7.4 Any indication that cannot be located on the OD must have an ID evaluation done for possible pitting, rod wear or other defects. The area of concern must be transferred to the ID and by use of an Ultrasonic Thickness gauge or magnetic particle and the type of flaw determined. If a Remaining Body wall calculation can be made this value will classify the pipe. If the location of the magnetic particle indication prevents exploration the joint shall be set aside for shear wave ultrasonic evaluation.

17.7.5 A indication that cannot be verified either as OD or ID with a response that exceeded threshold shall be set aside for shear wave ultrasonic evaluation; shall be reinspected for repeatability of the indication and if repeated set aside for ultrasonic shear wave evaluation.

17.7.6 Areas of OD wear shall be evaluated by determining the minimum wall in the area. This value shall be used to classify the pipe to premium, class 2 or class 3.

17.7.7 Stress induced diameter reductions will be classified based upon the minimum diameter determined by use of OD calipers and the caliper value of that diameter as determined by a machinists rule. This minimum diameter is recorded and the percentage of specified diameter value used for classification based on the establish tables of RP7G.

17.7.8 Diameter increases are evaluated using OD calipers and a machinist rule. The area of maximum diameter is measured and the resultant value as determined as a percentage of specified diameter becomes the value the pipe is classified to for diameter increases in RP7G.

17.7.9 Slip area cuts and gouges are evaluated as a percentage of adjacent wall (measured depth divided by the average adjacent wall multiplied by 100 for a percentage) and remaining wall. The remaining wall value shall be evaluated against the requirements of RP7G tables for longitudinal and transverse type imperfections.

17.7.10 Corrosion pitting in the pipe is evaluated as a remaining wall value. External corrosion has a subtracted depth from adjacent wall value; internal corrosion value is the lowest recorded wall value. Both final values are classed based upon the percentage for premium, class 2 and class 3.

17.7.11 Cracks are a rupture of the pipe shell. An OD crack that can be identified with magnetic particle or visual methods classifies the joint as scrap. There is no tolerance.

Cracks that are determined to be ID or subsurface flaws that are evaluated by shear wave ultrasonic methods using a reference standard with a 5% of specified wall, ½" long and .040" wide maximum which produce a signal that exceed this established threshold shall be scrapped. The inspector should be careful in determining an id indication to be a crack without looking into the ID with magnetic particles applied. Pitting and cracks should not be confused.

17.7.12 Cross Sectional Average is sometimes asked to be calculated where the requirements for high hook loads occurs. This inspection takes place at where the point on a joint that the ultrasonic readings are taken to verify the lowest recorded wall thickness. Wall thickness is taken at 1" intervals around the circumference of the material at this area. The wall values are then added and averaged. This resultant value becomes the average wall.

The average diameter shall be obtained by use of a "pi" (π) tape around the circumference.

Using the average diameter and the average wall calculate the cross sectional area by from the equation $A_{cs} = (D-t)(t)(\pi)$.

D= the average diameter t=the average wall π=3.1416

17.8 Reporting and Marking

17.8.1 All pipe will have a classification band applied to the pin end approximately 18" from the 35° sloping shoulder of the tool joint. The band color will correspond to the classification level, premium (two white), class 2(one yellow), class 3(one orange) or scrap (one red).

17.8.2 Each length of inspected drill pipe shall a unique sequence number stamped on the 35° sloping pin tool joint shoulder. If the pipe has previously issued serial number this number shall be referenced on all inspection run sheets with the sequence number and stamping of the sequence number will not be required.

17.8.3 Any downgraded pipe will have the area of downgrade identified with paint band around the tube in the defective area and the area boxed. The color of the band shall reflect the downgrade classification.

17.8.4 On the 35° tool joint shoulder adjacent to the serial number or the sequence number a steel stamp punch shall be applied for the classification of the drill pipe tube(1 punch premium, 2 punches class 2, 3 punches class 3, 4 punches scrap). In addition the inspection company symbol and the date of the classification should be stamped.

17.8.5 A final report listing all material by their respective class should be created electronically and a hard copy issued. All material downgraded should show the cause of downgrade.
17.8.6 This report and marking requirements apply only to the tube body inspection in accordance with this work instruction.
17.8.7 All records and reports stored in the computer shall be downloaded and kept with any other job related documents for the specified time for storage retention.

Revision History

REV.	Description of change	Effective Date
New	This section added	2-28-10
--	See Table of Contents for Complete Revision History	--

Section 18. VISUAL & DIMENSIONAL INSPECTION of Rotary Shoulder Connections

18.1 Scope

This work instruction covers the inspection of tool joints welded to drill pipe tubes being used in the drilling of Oil & Gas wells. Inspection will be performed primarily on used connections but in some circumstance may be applied to new tool joints when result of manufacture needs to be evaluated. Examination is performed to determine pipe grade, condition of the seal, threads, hard facing and bevel, evidence of box swell and pin stretch. BHA components are addressed in another work instruction.

18.2 Reference Documents

API Specification 7
API RP7G
Technical Industries, Inc. Qualification & Training Program
Technical Industries, Inc. Equipment Calibration Program.

18.3 Personnel Qualification

All personnel performing work within this work instruction shall have a qualification level that has satisfied the requirements of Technical Industries Quality and Training Program. All trainees will be supervised by a Level II.
All personnel shall have passed the Visual Acuity and Color Contrast eye examination of the program.

18.4 Required Equipment

- 1/64” graduated scale 12” metal rule
- Hardened and ground profile gauge
- OD/ID 8” length calipers
- 12” dial calipers
- Lead Gauge with appropriate points & setting standard
- High intensity Light
- 2x magnifying mirror, round, not cracked with a 1”or 2” diameter surface
- Grinders, wire wheels, soft wheels, wire brushes and solvents for cleaning.
- Files, 3 corner and flat, for field dressing of threads.

All measuring tools shall be calibrated to the Technical Industries, Inc. calibration program required intervals and methods.

18.5 Cleaning and Preparation

18.5.1 Areas to be inspected shall be clean and free from all dirt, thread dope, grease, rust, paint, lint and other types of foreign materials that can limit and interfere with the inspection process and accuracy.

18.5.2 Cleaning can be achieved with steam cleaners, soapy water, varsol or mineral spirits but final cleaning shall be achieved by buffing the connections, any stress relief features and other areas on the parts that require bare metal in order to perform a through visual and dimensional inspections.

18.6 Inspection

To adequately inspect non-API connections a field inspection manual with adequate criteria shall be available. All applicable inspections listed in this work instruction shall be performed along with additional inspection points that may be listed in the Proprietary Connection manual.

18.6.1 Visual Inspection

18.6.1.1 Visually inspect 100% of all connections for mechanical damage and corrosion. Areas of interest include, sealing surfaces, threaded areas, OD and ID surfaces. Attention shall be paid to damages such as galled shoulders, galled threads, mashed threads, fins, nicks, cuts, washes, pitting, ID profiles, OD reductions or any other damage that might interfere with the integrity of the connection.

18.6.1.2 Weight/Grade Stencils or the identification grooves on the pin and markings on the pin base shall be checked to verify they are consistent with the pipe identified on the work order. Missing markings shall be reported on the inspection report.

18.6.1.3 Bevel Width: an approximate 45 ° bevel at lease 1/32” wide shall be present for the circumference on both pin and box.

18.6.1.4 Thread surfaces shall be free of pits or other imperfections that appear to exceed 1/32” in depth or 1/8” in diameter, that penetrate below the thread root or that occupy more than 1 ½” in length along any thread helix. Raised protrusions must be removed with a thread file or soft buffing wheel.

18.6.1.5 Box Swell is checked using a straight edge placed alongside the box tool joint looking to see if a visible gap exists. If a gap exists the counterbore diameter shall be checked.

18.6.1.6 Seal Surfaces shall be free of raised metal or corrosion deposits detected visually or by rubbing a fingernail or metal scale across the surface. Any depression that might cause the connection to leak shall be noted. Depressions estimated to exceed 1/32" in depth or occupy more than 20% of the seal width at any location are rejectable.

18.6.1.7 Shoulder flatness shall be observed by placing a steel scale across the sealing shoulder on the box end and the chord of the sealing shoulder of the pin and rotate. Scale should be placed in multiple locations until the entire sealing face has been evaluated.
Note any area that is observed to be not-flat for repair.

18.6.1.8 Thread profile gauge shall be used to inspect the condition of the thread profile of both the pin and box for wear. Two profile gauge condition checks as a minimum should be made per connection. These should be 90° apart. The inspector should be looking for visible light between the gauge and the thread flanks, roots and crest. All gaps or imperfections should be marked and evaluated. Any evidence of stretching shall be evaluated using a lead gauge and appropriate standard.

18.6.1.9 Pin stretch is measured by placing a properly calibrated lead gauge with appropriate contact points in the last full depth thread at its closest point to the shoulder on the pin. Measurement is made by moving the gauge around the fixed contact while in contact with the thread flank in a small arc. Maximum fast or slow reading is noted. The measurement shall be over a 2" interval. Two measurements should be made 90° apart.

18.6.1.10 Cracks. All connections and tool joints shall be free of all visible cracks and heat checking, except for the hairline cracks in hard banding.

18.6.1.11 Hard banding shall be examined for broken or missing areas, cracks, blow holes, porosity, craters, raised carbide chips, depth of the valley between passes and hard band height. Hairline cracks in hard banding are common and are acceptable as long as they do not extend into base metal.

18.6.2 Dimensional Inspection

18.6.2.1 Tool Joint Outside Diameter (OD) is measured 1" from the sealing shoulder on both the box and pin. There should be at least two checks per tool joint 90° apart. The diameter determines the classification of the tool joint. Eccentric wear should be noted and evaluated in the shoulder width examination.

18.6.2.2 Pin ID shall be measured under the last thread nearest the shoulder. The maximum diameter shall be recorded. This determines the torsion strength of the tool joint and classification.

18.6.2.3 Bevel Diameters are measured and recorded. Measurements are made on pin and box at the intersection of the seal shoulder and the bevel. This value shall be recorded and evaluated against the listed values in RP7G or the proprietary tool joint manual.

18.6.2.4 Box Counter Bore Length is measured from the seal shoulder to the beginning of the taper section at the starting thread. This value shall be recorded and evaluated against the listed values in RP7G or the proprietary tool joint manual.

18.6.2.5 Box Counterbore Diameter is measured as near as possible to the shoulder at two places 90° apart. This value shall be recorded and evaluated against the listed values in RP7G or the proprietary tool joint manual.

18.6.2.6 Pin thread lengths shall be measured and recorded. The pin thread length is measured from the pin nose to the sealing shoulder. The length must meet the minimum and not exceed the maximum listed in RP7G.

18.6.2.6 Pin base length is measured from the point of first full depth thread nearest the shoulder and the sealing shoulder. This value shall be recorded and evaluated against the listed values in RP7G or the proprietary tool joint manual.

18.6.2.7 Box shoulder width is measured from a projection of the outside diameter surface to a projection of the counterbore at the plane of the 90° shoulder. A caliper is the most accurate tool for measurement. This value shall be recorded and evaluated against the listed values in RP7G or the proprietary tool joint manual.

18.6.2.8 Box seal width is measured at the smallest point of the corner of the outside bevel and the sealing face to the corner of the inside bevel and face. This value shall be recorded and evaluated against the listed values in RP7G or the proprietary tool joint manual.

18.6.2.9 Tong space of the tool joints shall be measured from the sealing shoulder to the corner of the tapered shoulder. If hard banding is present the measurement is from the tool joint face to the edge of the hard banding

nearest the tool joint face. This value shall be recorded and evaluated against the listed values in RP7G or the proprietary tool joint manual.

18.6.3 Re-facing

When re-facing is performed on Drill Pipe Tool Joints either API or non-API connections, when allowed by the manufacture, the least amount of material possible shall be removed.

Sealing surfaces rejected can possibly be field repaired by this method or the connection shall be removed from service.

The maximum amount of material to be removed at any one re-facing shall not be more than 1/32". Cumulative refacing without shop repair shall be no more than .062". This is a measurement against the benchmarks on the tool joint.

If benchmarks are not present there are two indicators if the maximum has been exceeded on connections to be refaced.

1. The pin base length measured from the first point of full depth thread exceeds .562".
2. The box counterbore is reduced to less than .562".

This not an assurance of connection condition but merely a guideline.

After refacing, the seal face shall be re-examined for flatness, seal width, pin base length or counterbore depth, and bevel diameter.

18.7 Evaluation and Classification

18.7.1 All visual and dimensional imperfections that are located during inspection must be evaluated against the job specification criteria. The specification can be customer spec, TH Hill DS 1, API PR7G or another relevant specification that has guidelines for acceptability to operating limits and guidelines.

18.7.2 Pipe with weight and grade stencils or identification grooves that are not present or do not correspond to the material description on the job order shall not be processed without customer notification and acceptance. Unless acceptance is authorized material shall be downgraded to scrap.

18.7.3 A bevel shall be present for 360°is required for acceptance. Bevel width must be at minimum 1/32" wide with an approximate 45° angle.

18.7.4 Pitting on threads that is in excess of 1/32" in depth or 1/8" in diameter or both, that penetrate below thread root shall be rejected. Pitting on the flanks and crests are acceptable as long as they do not extend more than 1.5" in surface

length. Pits, cuts, gouges in the last two threads are the most critical and care full evaluation is suggested.
Mashes, gouges and galls that produce protrusions may be cleaned up with a soft buffing wheel or a file. The profile of the threads must be gauged and meet the requirements of the profile gauge for acceptance after repair.

18.7.5 Thread evaluation with a profile gauge consisting of applying the gauge to the threads in the two 90° locations and observing the gaps between the flanks, roots and crests. When four consecutive thread **crests** exhibit a gap that is greater than .031" or .060" on two consecutive threads the tool joint is rejected. Gaps between the **flanks** and the gauge estimated to be more than .016" is cause for rejection. Any indication of stretching shall be evaluated using a lead gauge.

18.7.6 Pin Stretch is evaluated using a calibrated lead gauge with appropriate contact points set up on a calibrated setting standard for a reading over 2". Any reading that is in excess of +0.006" is cause for rejection. All stretched pins shall be inspected for cracks by aid of Magnetic Particle Inspection.

18.7.7 Cracks are automatic rejects.

18.7.8 Box swell most commonly is evaluated by measuring the counterbore (Qc) diameter at two places. Be cautious not to include the id bevel enlargement but the projected intersection of the seal face and the counterbore. The diameter shall not exceed the dimensions listed in the appropriate tables of RP7G.

18.7.9 Seal damage that can be corrected by refacing within the guidelines for refacing can be corrected in the field. If field refacing is not available or the repair is more than allowed by refacing the connection shall be taken out of service. Repair may be possible in a machine shop.

18.7.10 Shoulder not flat when detected prevents further use of the connection until correction occurs.

18.7.11 OD measurements of the tool jts. both pin and box determine the torsion strength of the tool jt to maintain 80% of the torsion strength of the pipe. Minimum values are given in the appropriate tables of RP7G.

18.7.12 Box Shoulder width measurement is the thickness of the tool jt from the OD to the counterbore measured at the point of less shoulder width from eccentric wear. This dimension is evaluated against the class for tool joint requirements in RP7G.

18.7.13 Box Seal width is the distance measured from the corner of the outside bevel and the sealing face to the corner of the inside bevel and face. This distance shall not be .047" smaller than the minimum shoulder width measurement specified for that class of tool joint in the tables of RP7G.

18.7.14 Bevel Diameters are measured and compared to the minimum required tool joint bevel diameter listed in the tables of RP7G. The values listed as maximum in these same tables are for field refacing acceptance guidelines.

18.7.15 Tong Space criteria should be provided by the user. Recommendations are that pin tool joints shall be 75% of the tool joint OD but not less than 4"; box tong space shall not be less the Length of the Box Connection as listed in the tables. Tool joints not meeting these criteria with user agreement shall be rejected.

18.7.16 Pin ID measurement is the controlling factor in determining the torsion strength of the tool joint to maintain 80% of the torsion strength of the pipe. The maximum ID measurement shall be compared to the requirements of the tables given in RP7G or the manufactures field hand manual.

18.7.17 Pin base length value shall be compared to the maximum allowed in the manuals. Any dimension exceeding this maximum is cause for rejection.

18.7.18 The pin thread length dimension shall be compared to the acceptable range given in RP7G or the manufactures manual. Dimensions outside of the range are reject.

18.7.19 Heat check cracking located within the first 2" of the box sealing shoulder and is deeper than .020" is non-repairable and cause for rejection. Heat check cracking equal to or less than .020" shall be removed or the tool joint rejected.

8.7.20 Hardband cracks are not cause for reject unless they extend into the base metal. Any hardbanding that appears not to be properly bonded or adhering to the surface to which it was applied shall be rejected.
The diameter of the hard banding shall be measured to determine how much is left and reported.

18.8 Reporting and Marking

18.8.1 Tool joint visual and dimensional classifications shall be recorded on the Drill Pipe Dimensional Log Sheet. Attachment 1.

18.8.2 Downgraded tool joints shall have a paint band in the centre of the tool joint. This paint band indicates the tool joint does not have the torsion strength that is at

least 80% of the required pipe body torsion strength. Yellow for Class 2 tool joint, Orange for Class 3 tool joints and Red for scrap.

18.8.3 All damaged tool joint connections that require shop repair will have a red band painted on the outside diameter adjacent to the sealing shoulder. The reason for rejection shall be written on the part next to the red paint band with durable marker that will sustain through the repair operations. Markings shall be removed after repair.

18.8.4 All field repairable connections not repaired at the time of inspection shall have a green band painted on the OD of the connection adjacent to the sealing shoulder. The reason for rejection shall be written on the part next to the red paint band with durable marker that will sustain through the repair operations. Markings shall be removed after repair.

18.8.5 Accepted tool joints shall have no bands applied. By not applying bands indicates the tool joint meets the classification of the tube condition for torsion and dimensional values as stated in the appropriate RP7G tables or the customer's specification.

18.8.6 Industry standard requires each drill pipe assembly receive a number at time of the entire assembly inspection. Dye stamps are used for this purpose with a punch indicating the class of the assembly. This is the lowest classification grade based upon the inspection of tube and tool joint condition. All serial numbers and classification punches shall be recorded on all documentation.
If tool joints only are being inspected the serial number must still be referenced on all documentation.

18.8.7 Prior to leaving location all connections shall receive a fresh coating of thread lubricant, and clean protectors install (if available). All job debris and miscellaneous trash shall be gathered and placed in appropriate gathering locations.
Job reports detailing all classifications shall be left on location with company representative. If possible material shall be segregated by classification given to the material.

Attachment 1

Technical Industries, Inc

DRILL PIPE CONNECTION DIMENSIONAL LOG SHEET

Customer: _____ **Well/Rig:** _____ **Date:** _____

Inspection Co: TECHNICAL INDUSTRIES,INC. **Location:** MILLER RD 1 **Page:** _____ **Of:** _____

Conn. Description: _____ **Pipe Supplier:** _____

	Box									Pin								
Jt. #	OD	Bev. Dia.	CB Length	CB Dia.	Shld. Width	Tong Space	Seal Width	Profile/Visual	Acc/Rej.	Grade	OD	ID	Bev. Dia.	Pin Length	Base Length	Tong Space	Profile/Visual	ACC/REJ

Boxes Prime _____ **Boxes Reject** _____ **Boxes RF** _____ **Pins Reject** _____ **Pins Prime** _____ **Pins RF** _____

Technical Industries, Inc

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Rev A - 02-22-10

REVISION HISTORY

REV.	Description of change	Effective Date
New	Added this section	2-28-10
--	See Table of Contents for Complete Revision History	--

Section 21- Black Light Inspection of Used Rotary Shoulder Connections

1 Scope

This instruction covers the examination of used rotary shoulder connections, acme connections and other types of connections, stress relief features, float bore features, weld areas and other areas of high stress by utilizing wet florescent magnetic particles illuminated by black light for flaws revealed by induction of a longitudinal magnetic field to exhibit transverse linear flaws.

2 Reference Documents

API Specification RP7G-2
API Specification Spec 7
TH Hill DS 1, Third & Fourth Editions
Technical Industries, Inc. Qualification & Training Program
Technical Industries, Inc. Equipment Calibration Program

3 Personnel Qualification

All personnel preforming work within this instruction shall have a qualification level that has satisfied the requirements of Technical Industries Quality and Training Program.
All Trainees will be supervised by a Level II.
All personnel shall have passed the Visual Acuity and Color Contrast eye examination of the program.

4 Equipment Required

4.1 Coils for longitudinal magnetization shall be of sufficient physical size to allow the parts to be placed inside or through the coil ID. The coil shall have the number of turns permanently marked on the exterior of the coil. Coils shall meet the output for calibration requirements of the Technical Industries, Inc. Equipment Calibration Program.

4.2 Power supply regulators for coils shall be utilized to control the amount of output of flux by the coil. The amp meter utilized on the supply must be operational, be calibrated for linearity of numeric control to the Technical Industries, Inc. Equipment Calibration Program.

4.3 Wet Fluorescent Magnetic Particles shall be made of magnetic retentive, low coercive force, finely divided ferromagnetic material.

4.3.1 Particles shall be controlled in accordance with ASTM E709.

4.3.2 Water based carrier shall be utilized for delivery of the particles to the surface of the part. If the surface does not wet without visible gaps a wetting agent should

be added to the carrier. Visible gaps should not occur from improper cleaning. The surface must be clean of all foreign residue.

4.3.3 If due to availability, clean water cannot be used and oil is used for the bath carrier; do not use oils or fluids with natural florescence. Varsol, #1 kerosene and Isopar-M are acceptable.

4.3.4 Non-Circulating wet flourcesent magnetic baths shall not be recycled.

4.4 Black Light Sources are ultraviolet light produced with a 100 watt mercury vapor bulbs. Intensity of the source shall be verified with use of a calibrated black light intensity meter. The intensity meter shall meet the calibration program sequence of Technical Industries, Inc.

4.5 An ASTM centrifuge tube with a stem marked in 1-mil(0.05 ml divisions) or equivalent.

4.6 Backlight tarps to darken the area of inspection.

4.7 A 1" and 2" magnifying mirrors with 2X power. They shall be clean and not broken.

4.8 Magnetic field indicators such as a pocket magnetometer and a flux indicator strip.

5 Preparation

5.1 All surfaces to be inspected shall be cleaned of all dirt, thread dope, grease, rust, coatings, paint, lint and other types of foreign materials that can limit the mobility of the magnetic particles and interfere with the accuracy of the inspection process.

5.2 As a secondary mode of cleaning, buff all machined surfaces such as stress relief features, float bores, outside surfaces, weld areas is acceptable. After buffing of the rotary shoulder connection the thread roots should be polished with a soft wheel to insure the surface cleanliness.

5.3 After final cleaning the areas for inspection should be rinsed with clean varsol or a non-detergent soap and clean water.

5.4 For non-circulating baths(sprayers) thoroughly shake the container left and right for 15-30 seconds. Activate the hose long enough to remove old solution. Take a 100 ml sample in the centrifuge tube. Allow the sample to settle in a non-vibration area for 30 minutes when using water and 1 hr. if using alternative carriers. The concentrate strength should be between **.1ml and .4 ml**.

5.4.1 The concentration level should be verified at the beginning of the job, every 8 hrs. thereafter.

5.4.2 If the settled particles appear to be loose agglomerates rather than a solid layer, take a second sample. If still agglomerated, the particles may have become magnetized and should be replaced.

5.5 Black light intensity should be verified using the calibrated BL meter after the bulb has been turned on and allowed to warm up for 30 minutes. The intensity should be verified at 15" from the light source or at the inspection distance, whichever is greater. Intensity should be not less than 1000mw/cm2.
If for any reason the Black light is shut off the intensity must be verified when restarted.

5.5.1 Visible light should be verified under inspection set up to be no more than 2 foot candles.

5.6 Determine the residual magnetic field polarity if present. Mark on the end the positive or negative polarity of the end.

5.7 Magnetic field strength, solution strength, Black Intensity shall be recorded on process record F-8.2.4-5.

6.0 Inspection

6.1 With all surfaces cleaned and equipment verified utilizing a size coil that allows the connection body to fill the coil inside diameter by over ½ place it over the connection with the same coil polarity as the connection polarity on the open side of the connection. The magnetization should enhance (add to) the existing field in the connection.

6.2 Activate the coil and keep active while the solution is sprayed over the entire surface of the area to be inspected. If possible roll the material 90 degrees during application. The coils magnetic field should be left on for 2-5 seconds after application of the solution has ceased.

6.3 Proper magnetic field orientation shall be verified under black light using the Castrol strip. The flux indicator should be placed on the ID of the connection with current on; solution applied and number of lines revealed on the flux strip noted. A min. of two lines is required with 3 lines being desired. Verification of flux direction and strength should be verified on the last part as well. The level of flux from this application should be noted with the magnetometer. The magnetometer should be used as the reference on each connection until re-verification.

6.4 The inspection surfaces of each connection shall be examined under black light. Each length should be rotated a min. of 360°. This should allow all areas under inspection puddles to be inspected. The inspectors expertise should verify this.

6.5 A 2X mirror shall be used on all box connection's for the thread roots. The last engaged thread on all connections should be closely examined.

6.6 Grinding to remove cracks is not permissible but areas with questionable indications may be re-cleaned with a non-metallic, non-abrasive buffing wheel. Solution re-applied and re-evaluated.

7.0 Acceptance Criteria

7.1 All relevant linear indications-cracks are cause for rejection.

7.2 Repair grinding of relevant indications is prohibited.

7.3 All parts with relevant indications-cracks shall be painted red.

8.0 Post Inspection

8.1 With the aid of solvent wash particle residue from the acceptable connections. Allow to dry.

8.2 At customer request and supplied a thread lube shall be re-applied to acceptable connections and if available protectors applied.

8.3 Rejected connections shall be left dry.

8.4 A white band shall be applied at base of connection shoulder noting acceptance at customer request. If not specified connection will be left with no band indicating acceptance.

8.5 If no other services are performed a service ticket and indicating pieces good and pieces rejected. If other services are performed connection acceptance/rejection shall be noted.

8.6 Parts will be demagnetized to less than 5 Gauss if customer requests.

9 Revision History

REV.	Description of change	Effective Date
New	Created	6-01-15