Chaparral ENERGY

December 3, 2013

Overnight Mail

US Department of Transportation
Pipeline and Hazardous Materials Safety Administration
Atten. Mr. R. M. Seeley
Director, Southwest Region
8701 South Gessner
Suite 1110
Houston, TX 77074

Re: PHMSA inspection of Chaparral Energy's CO2 Pipelines
CPF 4-2013-5026M (Notice Of Amendment)

Dear Mr. Seeley:

This letter is in response to your letter dated October 31, 2013 concerning the above reference subject. Enclosed is an updated copy of Chaparral's Energy's "Damaged or Defective Non-Leaking Pipe" policy which Chaparral now believes complies completely with section 195.402 in the Federal Pipeline Regulations.

Chaparral Energy received your letter on November 4, 2013, therefore with this letter and the enclosed policy, Chaparral Energy feels this "Notice of Amendment" is closed. If you have any questions please feel free to contact Mr. Donald Hankey at 405-255-6581 or at don.hankey@chaparralenergy.com.

Sincerely,
Chaparral Energy, Inc.

Mr. David Ketelsleger
SVP, General Counsel

cc: Mr. Donald Hankey

Enclosure: Chaparral Energy's "Damaged or Defective Non-Leaking Pipe" policy

Chaparral ENERGY

Damaged or Defective Non-Leaking Pipe

Policy

Damages or defects in pipe which DO NOT result in leakage or failure of the pipe must be repaired or removed in a prompt, safe manner with minimum operating downtime and in accordance with the following codes:

- ASME B 31.4, "Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids," current referenced edition.
- ASME B 31.8, "Gas Transmission and Distribution Piping Systems", current referenced edition.

  API Recommended Practice 1104, "Standard for Welding Pipe Lines and Related Facilities," current referenced edition.
- 49 CFR, Part 192, "Transportation of Natural Gas and Other Gas by Pipeline,"
- 49 CFR, Part 195, "Transportation of Hazardous Liquids by Pipeline"

This procedure is to be used by the "Company Representative" for Field evaluation of defects and to determine repair requirements for pipelines operating at pressures in excess of 275 psig (high pressure). Should circumstances prevent a permanent repair of a defect in accordance with this procedure, the problem shall be referred to the Pipeline Compliance Manager and EOR Department.

This procedure may be used to evaluate defects on pipelines operating at less than or equal to 275 psig (low pressure). If the evaluation calls for a permanent repair, the repair determination must be confirmed by the Pipeline Compliance Manager and EOR Department.

Under no circumstance is anyone empowered to supersede, change, or waive a required repair without the approval of the pipeline compliance manager and the EOR manager or their designee.

Analysis and Reporting

If a section of pipe appears to be recently and substantially damaged/defective, the pipeline shall be shut down with the line pack relieved as much as practical in a controlled process. The Production Forman shall determine the controlled process such that pressure at the damage/defect location shall be reduced. [See "Defect Discovery, Classification and Pipeline Restart" (Attachment A) and "Allowable Pipeline Operating Conditions" (Attachment B)]

If a section of pipe appears to be otherwise recently damaged/defective, the pipeline may either be shut down or the job site pressure held to a value that will not exceed 50 percent SMYS of the pipe involved. (For CO2 pipelines, reduce the pressure to 50 percent of SMYS or the lowest practical level that will maintain the CO2 in a liquid state, whichever is lowest.), using a controlled process determined by the Production Forman.

Investigation of anomalies found by in-line inspection does not require pressure limits during excavation and evaluation except as provided below.

- Metal loss anomalies with corrosion characteristics where the predicted metal loss results in a calculated pressure less than the MOP/MAOP of the line using the formula in section 451.7 of ASME/ANSI B31.4 (liquids) or ASME/ANSI B 31.8 (gas). The pressure at the job site during final excavation, cleaning, and evaluation should be limited to the B31.4 or B31.8 calculated pressure.

Dents with associated metal loss anomalies

The pressure at the job site during final excavation, cleaning, and evaluation should be limited to 50 percent SMYS. (For CO2 pipelines, reduce the pressure to 50 percent of SMYS or the lowest practical level that will maintain the CO2 in a liquid state, whichever is lowest.)

Dents with no associated metal loss anomaly

If a dent is found to be caused by the pipe resting on a rock or other hard object, the following shall apply while rock removal and a defect examination are conducted:

- The pipeline may continue to be operated normally provided that the dent has a predicted depth of less than 3 percent of the pipe diameter or is a smooth dent with a predicted depth not exceeding 6 percent.
- The pipeline may continue to be operated at a pressure not exceeding 50 percent SMYS (For CO2 pipelines, reduce the pressure to 50 percent of SMYS or the lowest practical level that will maintain the CO2 in a liquid state, whichever is lowest), at the job site for dents that are sharp in nature that have a predicted depth of between 3 and 6 percent of the pipe diameter.
- The pipeline shall be shut down and job site pressure reduced to the extent practical if the dent is predicted to be deeper than 6 percent.

If it is desired to lift the pipe off the rock prior to its removal, the procedures in 195.424 in Chaparral's "Part 195 Operations and Maintenance Manual" shall be followed.

To calculate the pressure corresponding to 50 percent Specified Minimum Yield Strength (SMYS), use the following:

= psi for 50% SMYS

Where SMYS = 30,000 for Grade A Pipe Steel

35,000 for Grade B

42,000 for X42

46,000 for X46

52,000 for X52

60,000 for X60

65,000 for X65

Tn = Nominal wall thickness, inches

D = Outside diameter, inches

When calling the Production Forman to request a pressure reduction, the caller should have the following information available:

- Line name / Identification
- Stake number, mile post, or Lat / Long
- Approximate elevation of job site
- Pressure for 50 percent SMYS or ASME / ANSI calculated pressure
- Company Representative and telephone number
- When work will be conducted

The Production Forman will determine the appropriate pipeline operating pressures to limit the jobsite pressure to 50% SMYS or for CO2 pipelines the lowest practical pressure.

Provide the Production Forman with as much advance notice as practical for pre-planned maintenance activity.

Provide the Production Forman with updates:

- When work is started.
- At progress points such as when the defect has been evaluated and when the repair work has started.
- When normal operation may be resumed.

After shut down or pressure reduction, a thorough inspection, test, and evaluation of the affected pipe and/or sleeve appurtenance fillet welds must be made to determine whether or not an "injurious defect" exists (see

"Defect Discovery, Classification and Pipeline Restart" (Attachment A)). When combination anomalies exist each anomaly must be examined separately. Select the repair method required by the most severe condition.

Testing must be conducted and all reports prepared by a qualified individual experienced in the use of nondestructive test methods.

- When evaluating defects associated with line pipe, a "Maintenance and Operations Report / Repair Sheet" and "Maintenance Record / Atmospheric Corrosion Inspection" must be completed.

Based on the results of this inspection, test, and evaluation, one of the following conditions will be indicated:

- No pipe defect exists; the only damage was to the coating.
- Wrinkle bend, corrosion, or a plain dent exists but is within acceptable limits because limitations on the size of the defect have not been exceeded.
- A potentially injurious defect exists.

If the inspection reveals that no defect exists, or that a wrinkle bend, corrosion, or plain dent exists but is within limits, the Company Representative may advise the Production Forman to resume normal operations and proceed to recoat the pipeline and back fill the trench without further approval.

If a potentially injurious defect exists, a repair determination must then be made per the following:

- Lamination Repair Determination (Attachment C)
- Stress Concentrator Repair Determination (Attachment D)
- Wrinkle Bend Repair Determination (Attachment E)
- Repair Determination for Stress Concentrators in Appurtenance Fillet Welds (Attachment F)
- Dent Repair Determination (Attachment G)
- Corrosion Pitting Repair Determination (Attachment H)

When multiple defects are present, select the repair method required by the most severe condition.

When an injurious corrosion defect is discovered, the pipe must be further excavated until inspection and evaluation indicate that the extent of the pipe with injurious corrosion defects has been found. In-Line-Inspection (ILI) logs should be reviewed for the presence of adjacent defects, if available. All defects inspected shall be correlated and identified using the defect numbering and the wheel count from the ILI log, if available.

If any pipe is uncovered for the purpose of tapping, relocation, or repair and it is determined that ovality is present, the pipe shall also be fully inspected for the extent of ovality.

- Ovality shall be measured by the Company Representative using calipers and straight edges.
- The measurements shall be recorded on the "Maintenance Record/Atmospheric Corrosion Inspection".
    - The "thin" dimension (diameter) and "wide" dimension (diameter) shall be measured and an o'clock position perpendicular to the "thin" dimension provided.
    - The percent "out-of-round" or deformation shall be calculated.
    - For example, using 8.625-inch outside diameter pipe and a measured "thin" dimension of 7.5 inches, the percentage "out-of-round" is as follows:

      [(Actual Diameter - "Thin" Diameter) / Nominal Diameter]*100

      For this example [(8.625-7.5) / 8.625]*100=13%

      The actual diameter shall be verified and used in the numerator and the nominal diameter in the denominator.
- The conditions present (i.e., depth of cover, foreign object or debris, traffic loading, etc.) when the ovality was encountered shall be noted on the "Maintenance Record/Atmospheric Corrosion Inspection".
- The Pipeline Compliance Manager, Production Forman, and the EOR Department shall be notified when ovality is encountered. Further actions, including re-inspection, shall be determined once the notification is made.

Equipment

Inspection and evaluation of damages or defects necessitate the use and technical understanding of the following nondestructive testing equipment:

- "Ultrasonic Flaw Detector" - Used to determine wall thickness and to locate the presence of flaws in the pipe wall and/or fillet welds.
    - A Straight Beam (dual element) Longitudinal Wave Transducer is used to determine wall thickness and locate laminations in the pipe.
    - An Angle Beam (single element) Shear Wave Transducer is used to locate flaws, especially vertical flaws, in the pipe and / or fillet welds.
- "Optical Micrometer" or "Pit Gauge" - Used to determine depth of pipe faults at a defect.
- Dye Penetrant Application - Used to determine the presence of crack - like flaws in the surface of steel.
- 20% Ammonium Persulfate solution application is used to confirm surface removal of arc burns.
- "Calipers" - Used to determine irregularities in pipe roundness and to make defect measurements.
- "Magnetic Particle Flaw Detector" - Used to locate crack-like flaws in a pipe wall.

Determining the Repair Method

Where a potentially injurious defect has been determined to exist, the repair selection shall be made by the local Pipeline Compliance Person and Production Forman in consultation with the Pipeline Compliance Manager and the EOR Department. Repair methods include:

Permanent Repair - Follow the permanent repair procedure as determined by the appropriate exhibits.

- Remove the pipe cylinder containing the defect and replace with certified (pretested) pipe.
- Repair the defect using a Type "B" sleeve with filler (per Type B Repair Sleeve (Attachment I).
- Repair the defect using a steel Type "A" sleeve or non-metallic compression repair sleeve (per Type A Repair Sleeve and Repair Procedure (Attachment J) and Non-Metallic Compression Repair Sleeve (Attachment K)). Use non-metallic compression repair sleeves when a steel repair sleeve installation is not practical (i.e. on bends, on out-of-round pipe, at inaccessible locations). Non-metallic compression repair sleeves are permitted for permanent repair of:
    - External metal loss not exceeding 80 percent of pipe wall thickness
    - Plain dents
    - Laminations
    - Wrinkle bends

  Acceptable non-metallic compression repair sleeves include:

    - Clock Spring
    - Armor Plate
    - Black Diamond Composite Wrap

      Note: People using these repair methods must meet Manufacturers training requirements along with operator qualification requirements for the procedure.
- Repair the defect using a repair patch (per Weld-on Patch (Attachment L) and Welding Manual).
- Repair the defect using Deposited Weld Metal repair (per Welding Manual).
- Remove the defect by grinding.

Temporary Repair - Temporary repairs are divided into two classifications, Pressure containing and Structural reinforcement. Pressure containing repairs may be used where Structural reinforcement is the allowed option. See the repair determination flow charts for temporary repair requirements.

- Pressure Containing Repairs
    - An approved bolted split sleeve (per "Plidco" Split-Sleeve for Temporary Repair of Pipeline Defect (Attachment M).
    - Pads and Lahey clamps (for externally visible defects only).
    - A Type "B" sleeve with filler (per Type B Repair Sleve (Attachment I)
- Structural Reinforcement Repairs
    - A Type "A" sleeve with filler that is held in place using "Gaso" clamps spaced in accordance with "Use of "Gaso" (Attachment S) Clamps to Hold Type "A" Sleeve Material without Welding".
    - A non-metallic compression repair sleeve.

Following installation of any temporary repair, the pipeline may be restarted. However, until permanent repairs are initiated, maximum operating pressure of pipelines repaired with either a bolted split sleeve or a Type "A" sleeve with filler (that is held in place using "GASO" clamps (Attachment S)) shall not exceed 1000 psi, except that Plidco split sleeves may be operated at the manufacturer's rating or the pipeline's Maximum Operating Pressure, whichever is lower. Pipelines repaired by any other temporary means (e.g., Lahey clamp) shall not be restarted without prior consultation with the EOR Department. Mechanically clamped repairs should be left exposed. A plan and schedule should be developed for the replacement of all mechanically clamped temporary repairs at the first practical opportunity. (NOTE: Reducing the pipeline's MOP by more than 20 percent may require submission of a Safety Related Condition Report. See 195.55 in the Chaparral "Part 195 Operations and Maintenance Manual" for liquid pipelines and 191.23 in the Chaparral "Part 191 and 192 Operations and Maintenance Manual" for gas pipelines.)

Plain Dent

A plain dent is a local change in surface contour greater than .25" in depth without a reduction in wall thickness or change in character of the metal. (It does not decrease ultimate bursting pressure but does decrease minimum yield pressure.) The steel in the dent yields at low pressure and tends to return to its original contour. Pressure cycling may cause fatigue cracks to form in or around the dent due to this repetitive movement of the wall of the pipe relative to the surrounding wall. These cracks often start on the inside surface of the pipe and may not be detected by visual or dye penetrant inspection. However, magnetic particle inspection may detect sub-surface cracks and therefore is more useful for this application. Dents that are "sharp" in nature have a greater potential for containing cracks and present a higher probability of failure. See External Pipeline Defect Illustrations (Attachment N).

A dent may be seen as a relatively sharp indentation and can be readily measured with a straight edge and gauges. Where less apparent smooth (that is, not sharp) dents occur as a gradual change in diametric shape (over several feet of pipe), use calipers as the measuring tool.

A plain dent does not contain scratches or micro cracks.

Plain dents shall be measured as the gap between the lowest point of the dent and a prolongation of the original pipe contour, in any direction, or as a deviation from the original diameter (using calipers and straight edges). A plain dent is considered to be "sharp" if its length/depth ratio along the longitudinal axis of the pipe is less than 30 or if it is concave in the circumferential direction.

All dents shall be checked with dye penetrant or magnetic particle inspection throughout the entire affected area of the dent to determine if cracks are present. If cracks are found see "Stress Concentrator" section below.

Repair Determination:

- A plain dent that is "smooth" requires no repair if its depth is less than or equal to 0.250" (pipe smaller than 12.75" diameter), or less than or equal to 2% (pipe 12.75" diameter and larger) of the nominal outside pipe diameter and does not occur within the heat affected zone of either a girth weld or a visually observed longitudinal seam weld.
- All dents greater than .25" deep that occur within the heat affected zone of either a girth weld or a visually observed longitudinal seam weld require repair.
- All "sharp" dents in excess of .25" deep require repair.
- See applicable "Repair Determination".

Stress Concentrator

A defect, characterized as a scratch, gouge, arc burn, notch, undercutting, stress corrosion cracking, visible surface crack, or cracks confirmed by any non-destructive method, is considered a stress concentrator, which decreases both the minimum yield pressure and ultimate bursting pressure of pipe.

A concentrator is often accompanied by microscopic cracking, reduction in wall thickness, and/or metal discoloration.

Shallow surface blemishes or pattern type mill rolling imperfections which occurred during the pipe manufacturing or coating process are not stress concentrators, if the depth of the roll imperfections is less than 3% of the nominal wall thickness. Mill type imperfections less than 3% of the nominal wall thickness do not require removal.

Repair Determination:

- Approved methods for concentrator removal include the use of the following: metal hand file, flexible disk sander/grinder, and a power wire wheel. **Hard disk power grinding is not permitted**. Removal of a concentrator shall be discontinued once the remaining wall thickness has been reduced below the greater of 0.125" or 60% of the specified nominal wall thickness. Remaining wall thickness below these levels requires complete defect removal as a cylinder or installation of a "B" sleeve.
- Verify complete removal of microscopic cracks with dye penetrant testing or magnetic particle inspection. For arc burn removal verification, spray the area with a 20% solution of Ammonium Persulfate. If the burn has not been completely removed, a black spot will form.
    - See applicable "Repair Determination".

Evaluation of defects located in the carrier pipe at the heat-affected zone of an appurtenance fillet weld:

- Cracks that exceed a depth of 12-1/2% of the nominal wall thickness and have a length of 1/8" or greater are not removable by filing or grinding and must be removed from the pipeline as a complete appurtenance cut out.
    - Cracks that exceed 12-1/2% of the nominal wall thickness in depth but are less than or equal to 40% of the nominal wall thickness in depth do not require reduced operating pressure until removal as a cylinder. If possible, the excavation shall remain open and protected with the appurtenance firmly supported until its removal.
    - Cracks that exceed 40% in depth require reducing operating pressure to 80% of the maximum operating pressure observed in the 30-day period prior to evaluation or pipeline shutdown and shall be scheduled for removal promptly as a cylinder. The excavation shall remain open and protected until removed. Cracks in this category meet DOT REPORTING criteria.

Toe cracks with a depth less than or equal to 12-1/2% of the nominal wall thickness, regardless of length, can be removed by filing or grinding.

Undercutting that exceeds either a depth of 0.031" or 12-1/2% of the nominal wall thickness must be repaired by welding in accordance with API-1104, Section 7.0.

Undercutting that does not exceed minimums in the above paragraph and falls between 0.016" and 0.031" or 6% and 12-1/2% of the nominal wall thickness requires no further repair if the accumulative length does not exceed 2" in any continuous 12" of weld. If the accumulative length exceeds 2" in any continuous 12" of weld, it must be repaired by welding in accordance with API-1104.

Undercutting less than or equal to 0.016" and less than or equal to 6% of the nominal wall thickness requires no repair regardless of length.

Localized Corrosion Pitting

A corrosion pit is a conical or crater-shaped void in the pipe wall caused by electrolytic corrosion. Such pits are normally not stress concentrators and, providing their area and depth are not large, do not decrease either the minimum yield pressure or the ultimate bursting pressure of the pipe. However, individual corrosion pits, in close proximity to one another, may weaken the pipe to an extent where repair or replacement is required. The interaction of these closely associated pits is defined as Type I interaction if their closest dimension(s) are measured around the girth of the pipe, and Type II interaction if their closest dimension(s) are measured axially along the pipe (See "Attachment O" for Type I and II interactions).

Localized corrosion pitting is discussed in Part 192.485(b) for gas pipelines and Part 195.585(b) for liquid pipelines.

Repair Determination:

- General or localized corrosion pitting with depths less than 12.5% of the specified nominal wall thickness (regardless of chain length) require no calculations or permanent repairs.
- General or localized corrosion pitting with depths greater than 12.5% of the specified nominal wall thickness may require evaluation of the interaction of corrosion-caused metal loss areas as well as the simple depth of the localized corrosion. Refer to Type I interaction and Type II interaction (Attachment O).
- External or internal grooving-type corrosion in electric resistance welded seams (ERW), electric induction welded seams, or electric flash-welded seams shall be removed or repaired.
- Corrosion Pitting Repair Determinations (Attachment H) provides a guide to if and when a repair is required. In general, metal loss in excess of 12.5% but less than 60% may require an A-Sleeve, depending on the interaction of localized corrosion area. Metal loss depths between 60% and 80% will require an A-Sleeve, a B-Sleeve, or a non-metallic compression repair sleeve. Metal loss in excess of 80% will require removal as a cylinder or other approved temporary or permanent repair.
    - Type I interaction – If the circumferential separation distance is greater than or equal to six times the nominal wall thickness, the areas shall be evaluated as separate anomalies. If the separation distance is less than six times the wall thickness, the areas shall be evaluated as one defect, using the overall length and the deepest depth.
    - Type II interaction – if the axial separation distance is greater than or equal to one inch, the areas shall be evaluated as separate anomalies. If the axial separation distance is less than that, the anomalies shall be evaluated as one defect, using the overall length and the deepest depth.
        - Field measurements at the corroded area include maximum pit depth (C) and actual chain length as measured along the longitudinal pipe axis, and/or around the circumference of the pipe. Maximum permissible chain length (Lp) shall be calculated in accordance with the equation in "Corrosion Chain Length Analysis" or obtained from "Values of Maximum Permissible Chain Length" (Attachment P).
        - For repair determination, see applicable "Repair Determination".

Whenever any pipe is removed, the internal surface must be inspected for evidence of corrosion, this inspection shall be documented on the "Maintenance Record/Atmospheric Corrosion Inspection" report. If internal corrosion is found, adjacent pipe shall be investigated to determine the extent of the corrosion. The pipe must either be replaced or the operating pressure must be reduced to be commensurate with the strength of the pipe, based on the actual remaining wall thickness (ASME B31G); the pipe cannot be repaired.

Laminations

A lamination is a void in the pipe wall containing a layer of non-metallic material and/or an overlapping layer of incompletely fused metal.

Blind laminations (i.e., a material layer which does not come to the pipe surface) parallel to the surface of the pipe wall and which are at least 1/2 pipe diameter from the nearest weld or branch connection opening do not decrease the ultimate bursting pressure or the minimum yield pressure of the pipe and shall require no repair.

Defect type laminations decrease the ultimate bursting pressure and minimum yield pressure of the pipe and are considered to be injurious defects if:

- The layer is at an angle to the surface of the pipe wall.
- The layer intersects a butt weld location cut line.
- The layer exists within 1/2 pipe diameter of a fillet weld or branch connection opening.
- The layer is at the interior or exterior surface of the pipe wall. The above conditions are illustrated in Defect Lamination Illustrations (Attachment Q).

Repair Determination

- Defect lamination is visually observed or discovered by ultrasonic testing, repair in accordance with the appropriate procedures of "Repair Determination".

Wrinkle Bends

Wrinkle bends (buckles, ripples or wrinkles) are a cold worked deformation of the pipe wall thickness and circumference involving sharp and irregular bend radii.

The current ASME B31.4 edition referenced in this repair policy does not allow the existence of wrinkles to be left in a pipe field bend as part of any new pipeline construction. Generally, pipe systems constructed prior to 1962 might have cold field bends containing wrinkles.

For small wrinkles, which exhibit no cracks, no repair is required if the crest to trough dimension (h) meets the required criteria. In general, the criteria are based on the ratio of h divided by the pipe diameter, multiplied by 100 (h/d * 100). However, the MOP of the pipeline and the wall thickness must also be known. Magnetic particle inspection must be used to verify the absence of cracks.

A diagram of a wrinkle bend is provided in "Attachment N". Tables of allowable h/D values are provided in "Maximum Values of h" (Attachment R).

Repair Determination:

- Approved repairs include pipe replacement, A-sleeves, B-sleeves, or Mechanical bolt-on clamps. If clamps or sleeves are used, an epoxy filler must be used to fill the space between the sleeve/clamp and the pipe. Since these defects are usually located in an existing bend, the replacement of the pipe section may be required if approved repairs cannot be accomplished in accordance with the procedure.
- See "Wrinkle Bend Repair Determination" (Attachment E) for permanent repairs.

Repair Determination:

- See applicable "Repair Determination" for permanent repairs.
- **Note**: Temporary repairs may be made to wrinkle bends with clock springs and epoxy filler.

Procedure for Addressing Acetylene Girth Welds

Applicability of Procedure

This procedure is applicable to mainline pipelines where acetylene girth welds have been determined to exist.

Location of Acetylene Weld Reinforcement Collars ("Collars")

Collars shall be installed at acetylene girth welds on above- and below- ground piping.

Collars shall be installed at all acetylene girth welds within 60 feet of either side of the midpoint at an excavation.

Approach to Work Site

A Company Representative shall locate and flag the location of the pipe.

A Company Representative shall also determine and designate the location of a traffic pattern for construction equipment such that loading over the top of the pipeline is minimized.

The section of pipe exposed as a result of excavation is not to be moved. A Company Representative shall review the requirements in the Maintenance Manual to prevent excavation of pipe exceeding the allowable length for unsupported pipe.

Installation of Collars

Prior to the installation of any collar, the surface of the pipe and the acetylene weld shall be cleaned to bare metal.

The wall thickness of the pipe in the vicinity of the fillet welds that will fasten the collar to the pipe shall be determined by use of Ultrasonic Flaw Detector (Straight Beam - dual element Longitudinal Wave Transducer). A minimum of 0.200" wall thickness is required to attach a collar.

Collars shall be installed in accordance with manufacturers' specifications. The collar shall be positioned such that the raised section of the collar is directly over the acetylene girth weld and the outside edge is in contact with the pipe. Limited grinding of the cap of the acetylene weld shall be permitted to achieve installation of the collar.

The collar shall be attached at each of its two outside edges and one overlapping edge using a fillet weld according to the welding procedure in the Welding Manual.

The fillet welds shall be visually inspected by means of a Magnetic Particle Flaw Detector when the ambient temperature is below 40 degrees F. Otherwise, Dye Penetrant (fluorescent) can be used for inspection.

Procedure for Addressing Threaded and Collared Pipe Joints

Applicability of Procedure

This procedure is applicable to the mainline pipelines where threaded and collared pipe joints have been determined to exist.

Location of Fillet Weld Reinforcement of Threaded and Collared Pipe Joints

Fillet weld reinforcement shall be performed at all exposed threaded and collared pipe joints not previously reinforced and determined to exist during inspection of the pipe.

Fillet weld reinforcement shall be performed at all exposed threaded and collared pipe joints within 60 feet of either side of the midpoint at an excavation.

Approach to Work Site

A Company Representative shall locate and flag the location of the pipe.

A Company Representative shall also determine and designate the location of a traffic pattern for construction equipment such that loading over the top of the pipeline is minimized.

The section of pipe exposed as a result of excavation is not to be moved. A Company Representative shall review the requirements in the Maintenance Manual to prevent excavation of pipe exceeding the allowable length for unsupported pipe.

Installation of Fillet Weld Reinforcement

Prior to the installation of any fillet weld reinforcement, the surface of the pipe and the threaded and collared pipe joint shall be cleaned to bare metal.

The wall thickness of the pipe in the vicinity of the fillet welds that will fasten the collar to the pipe shall be determined by use of Ultrasonic Flaw Detector (Straight Beam - dual element Longitudinal Wave Transducer). A minimum of 0.200" wall thickness is required to perform fillet weld reinforcement.

Fillet weld reinforcement is not to be performed if pipe threads are visible. Contact the EOR Department and Pipeline Compliance Manager for recommended repairs.

Fillet weld reinforcement shall be performed according to the welding procedure located in the Welding Manual.

The fillet welds shall be visually inspected by means of a Magnetic Particle Flaw Detector when the ambient temperature is below 40 degrees F. Otherwise, Dye Penetrant (fluorescent) can be used for inspection.

Definitions

Ta - Actual (field measured) pipe wall thickness immediately adjacent to the defect.

Tn - The manufacturer's standard nominal wall thickness for the pipe. It is not the actual thickness of the pipe wall immediately adjacent to the defect, which may fall within a tolerance range of plus 15% or minus 12.5% of the standard nominal wall thickness. If a field measurement shows that the actual pipe thickness is outside of this range, it is likely that the records are in error, and the Pipeline Compliance Manager and the EOR Department should be consulted to determine which value of Tn is to be used.

Tr - Actual remaining wall thickness (field measured) of a defect. Where stress concentrators are involved, Tr shall be defined as a measurement after removal of the defect. To estimate Tr prior to defect removal, subtract the pit gage reading from the actual wall thickness adjacent to the defect.

c - Maximum depth of corrosion pitting measured between the lowest point of the deepest pit and a prolongation of original pipe contour.

La- The measured chain length of contiguous pits having sufficient depth such that Tr is less than 87.5% of Tn. Adjacent and contiguous pitting where Tr is greater than 87.5% of Tn is to be ignored when selecting the end points for measurement. Use F-1 to determine la.

Lp - Calculated permissible chain length (inches).

Hw - Wrinkle bend height as measured from the trough to the crest of the wrinkle. See External Pipeline Defect Illustrations.

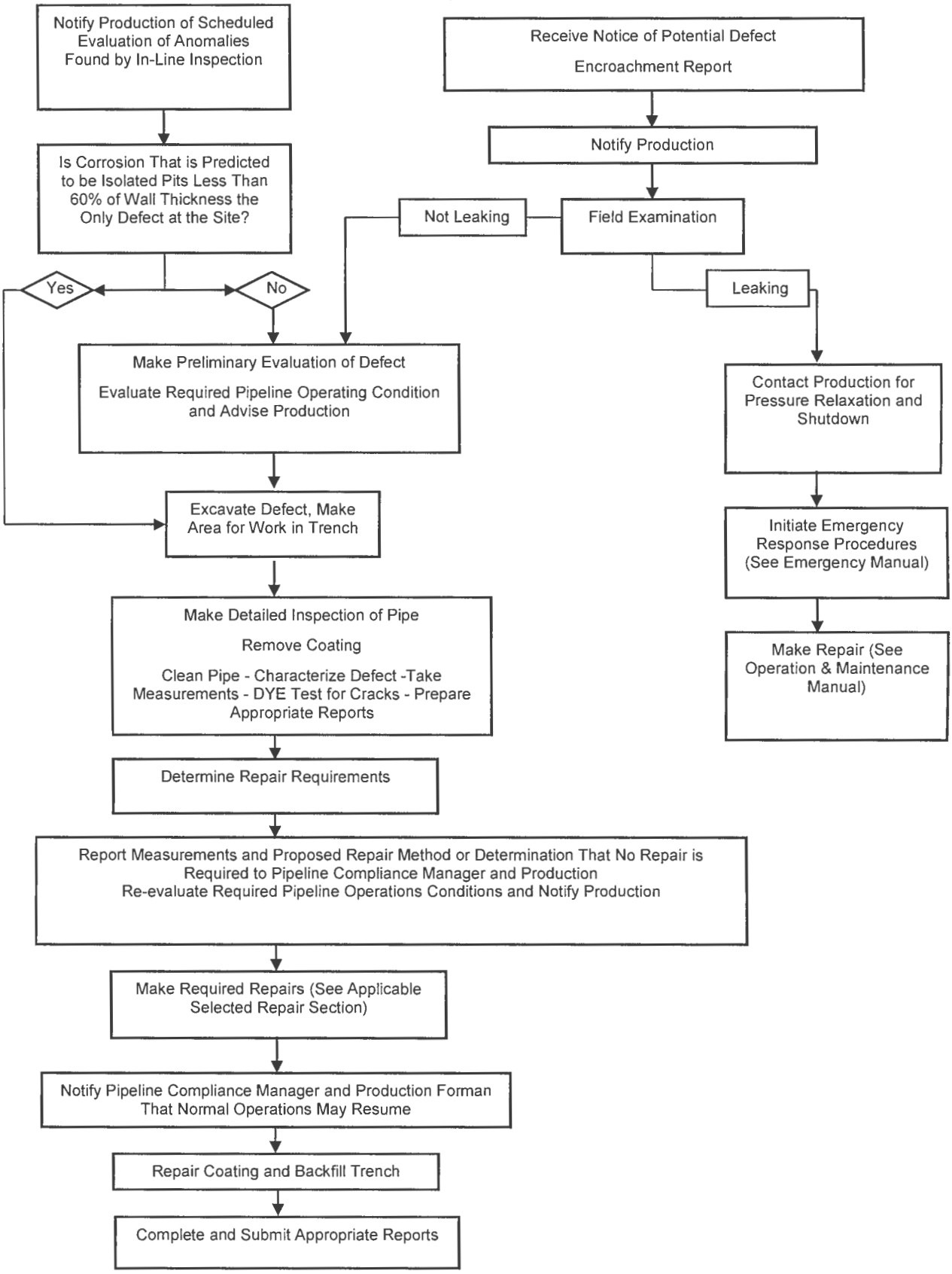
Lw - Crest to crest length of wrinkle bend. See External Pipeline Defect Illustrations (Attachment N).

Company Representative - A responsible individual who has received training in the application of this policy, defect measurement and analysis, defect removal techniques, and the consequences of allowing injurious defects to remain in the pipeline and has been given authority to make decisions in accordance with this policy.

Reference: 49 CFR Parts 192.711, 192.713, 192.715, 192.717; 195.416; 195.585

Defect Discovery, Classification and Pipeline Restart

(Attachment A)



Allowable Pipeline Operating Conditions During Defect Investigation and Repair

(Attachment B)

The conditions listed below require pipeline shutdown or pressure limits at the job site. The operating condition of the pipeline should be reviewed periodically as the investigation and repair operation proceeds and at any time that new information about the defect becomes known. At a minimum evaluate conditions:

- On arrival at the site.
- After excavating the defect.
- After the pipe has been cleaned and measurements taken.
- Prior to beginning the repair.

Notify production at once of any required change in operating conditions or the ability to resume operations.

Conditions Requiring Pipeline Relaxation and Shutdown

- Leaking defects.
- Excavation, examination, and removal of gouges with apparent metal loss.
- Excavation, examination, and removal of cracks.
- During rock removal and examination of dents greater than 6% deep.
- While installing a deposited weld metal repair (see welding procedures).

Conditions Requiring Pipeline Shutdown (line pack may be held)

- While installing a "B" sleeve on certain pipe types (see welding procedures).
- While installing a patch on certain pipe types (see welding procedures).

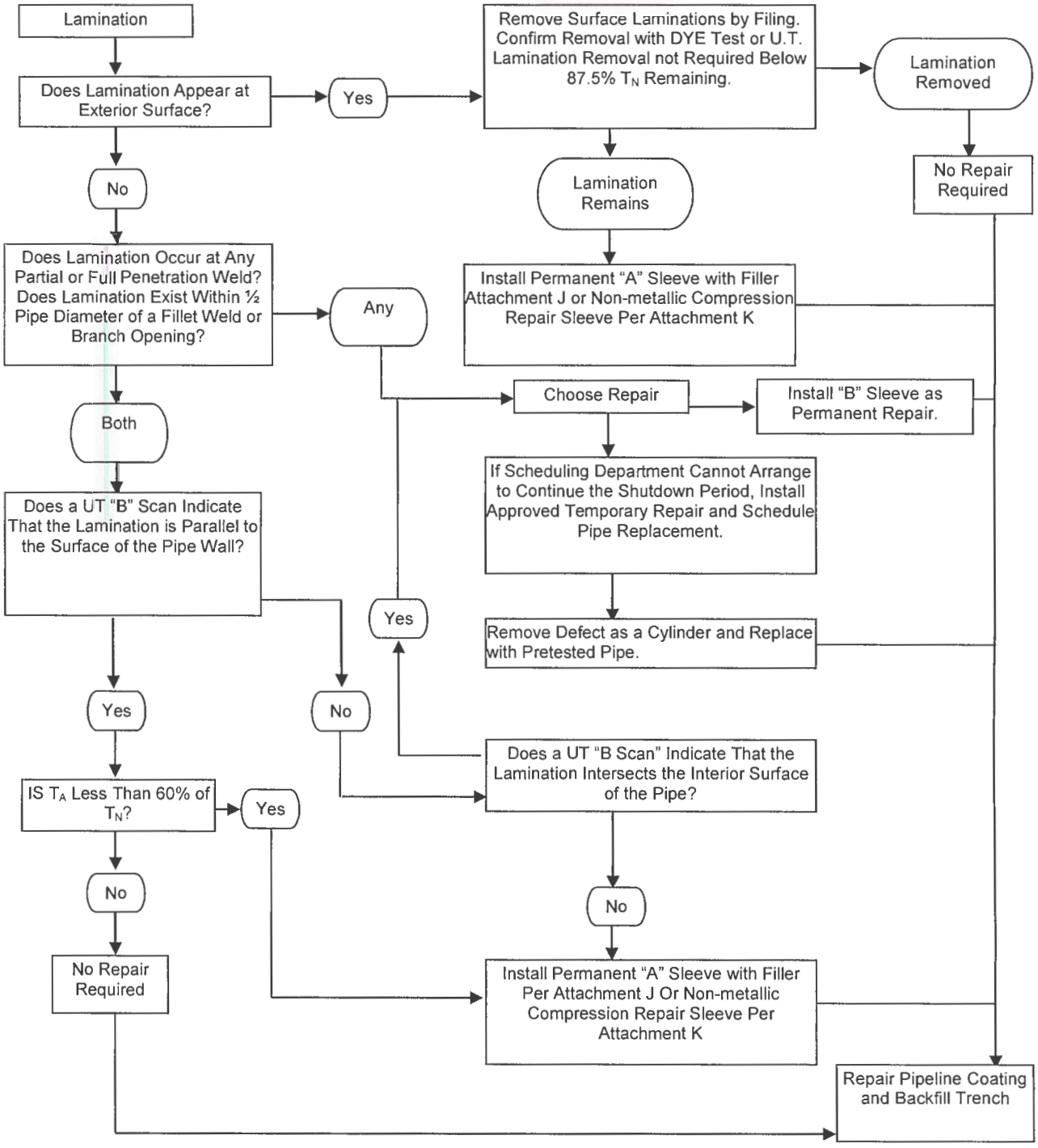
Conditions requiring 50% SMYS Pressure Limits at Job Site

- Excavation and examination of any recently incurred damage not requiring a shutdown. (e.g. Scratches in pipe surface).
- Excavation and examination of any corrosion defect identified by in-line-inspection predicted to have less than 40% wall thickness remaining.
- Presence of field measured corrosion pitting with less than 20% wall thickness remaining.
- During rock removal and examination of sharp dents between 3 and 6 % deep.
- Presence of fillet weld toe cracks in excess of allowable limits.
- While installing an "A" sleeve.
- While installing a non-metallic compression repair sleeve.
- While installing a "B" sleeve on certain pipe types (see welding procedures).
- While installing a patch on certain pipe types (see welding procedures).

It is always appropriate to request a shutdown if the investigator is unsure of the extent of damage to the pipe.

Lamination Repair Determination

(Attachment C)

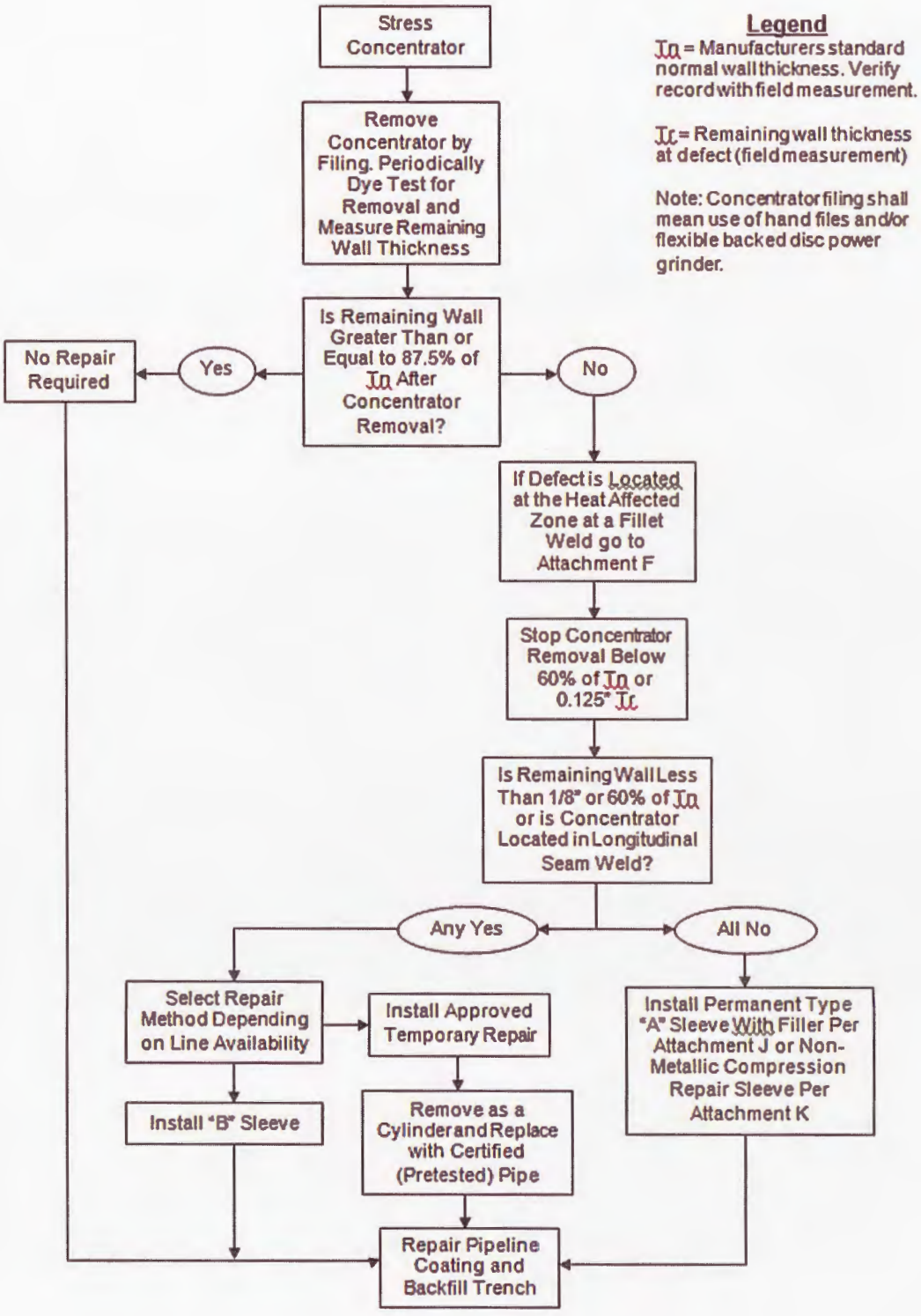


Legend See Definitions.
T_n Manufacturers standard normal wall thickness.
Verify record with field measurement.

Note: Concentrator filing shall mean use of hand files and/or flexible backed disc power grinder.

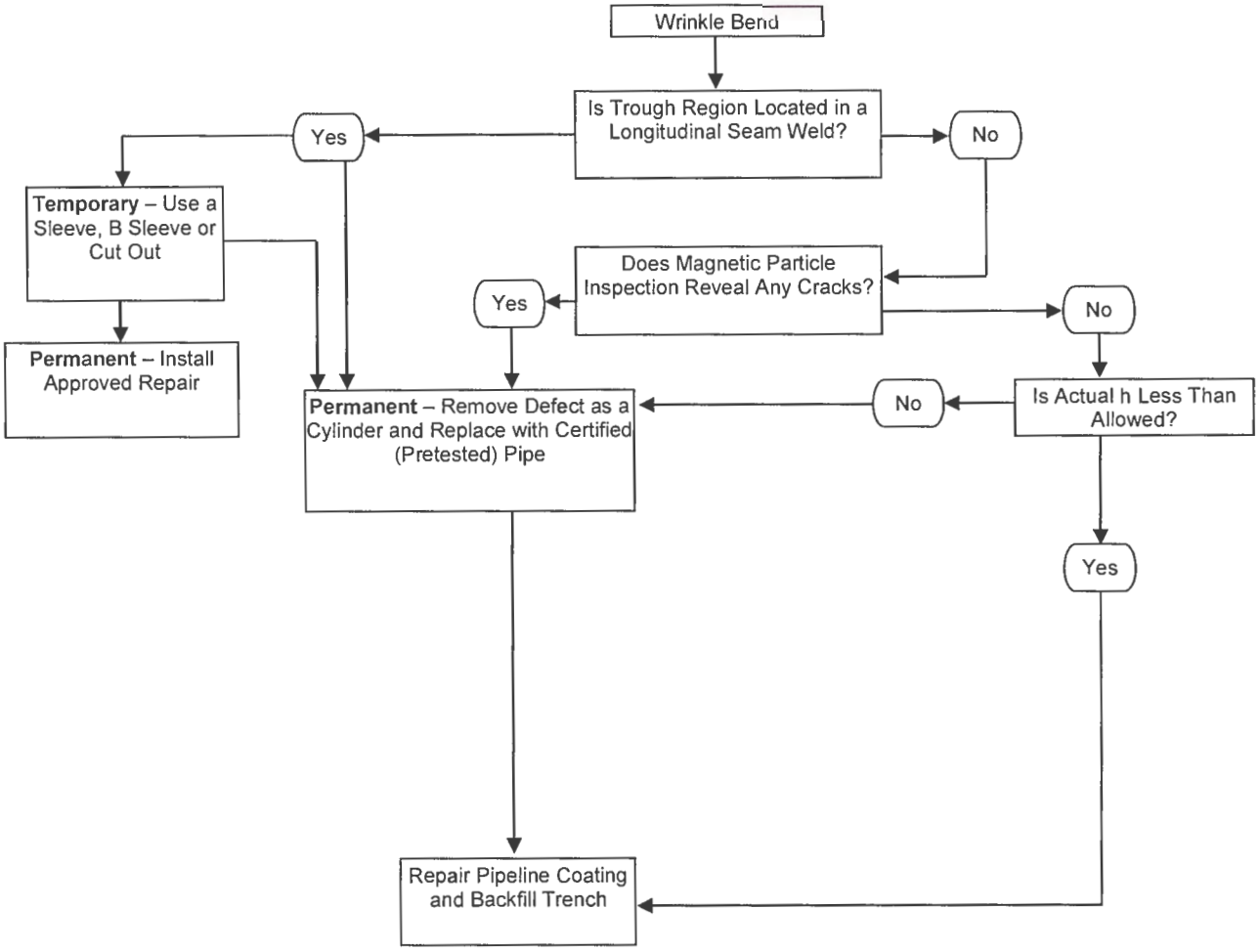
Stress Concentrator Repair Determination

(Attachment D)


Stress Concentrator
Remove Concentrator by Filing. Periodically Dye Test for Removal and Measure Remaining Wall Thickness
Is Remaining Wall Greater Than or Equal to 87.5% of Tn After Concentrator Removal?
Yes
No Repair Required
No
If Defect is Located at the Heat Affected Zone at a Fillet Weld go to Attachment F
Stop Concentrator Removal Below 60% of Tn or 0.125" Tr
Is Remaining Wall Less Than 1/8" or 60% of Tn or is Concentrator Located in Longitudinal Seam Weld?
Any Yes
All No
Select Repair Method Depending on Line Availability
Install Approved Temporary Repair
Install "B" Sleeve
Remove as a Cylinder and Replace with Certified (Pretested) Pipe
Install Permanent Type "A" Sleeve With Filler Per Attachment J or Non-Metallic Compression Repair Sleeve Per Attachment K
Repair Pipeline Coating and Backfill Trench
Legend
Tn = Manufacturers standard normal wall thickness. Verify record with field measurement.
Tr = Remaining wall thickness at defect (field measurement)
Note: Concentrator filing shall mean use of hand files and/or flexible backed disc power grinder.

Wrinkle Bend Repair Determination

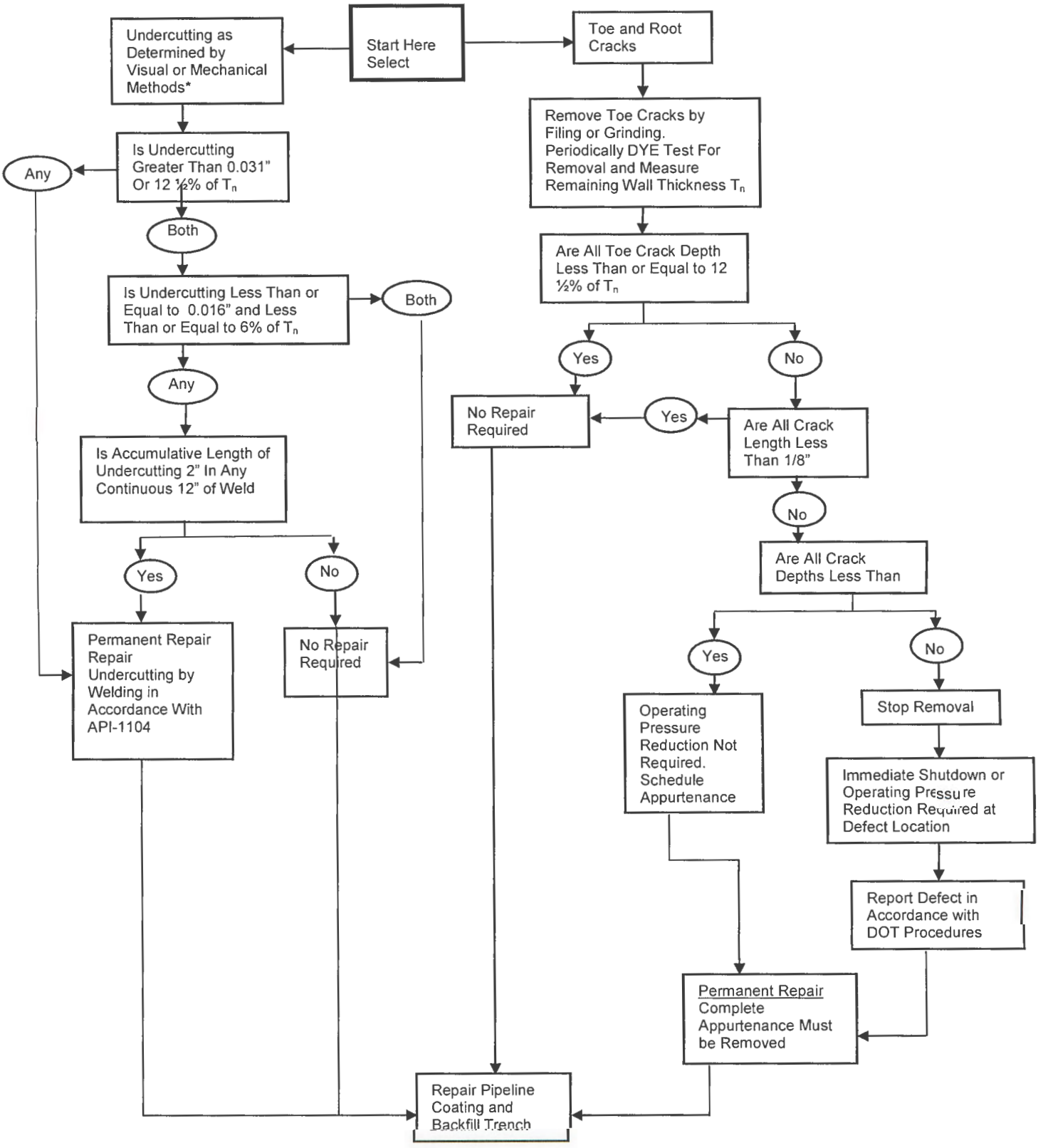
(Attachment E)



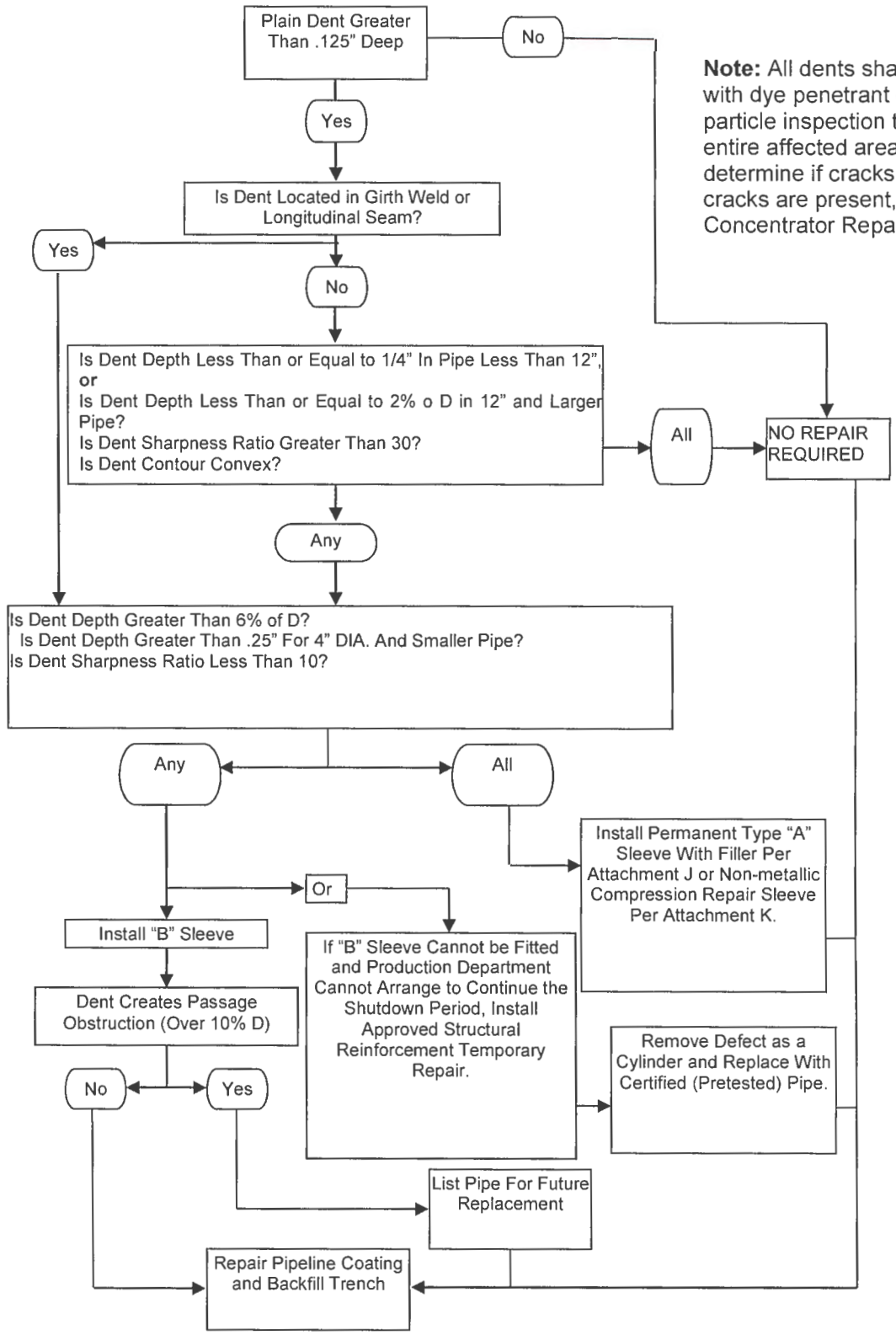
H = crest to trough height
D = pipe diameter

Repair Determination for Stress Concentrators In Appurtenance Fillet Welds

(Attachment F)



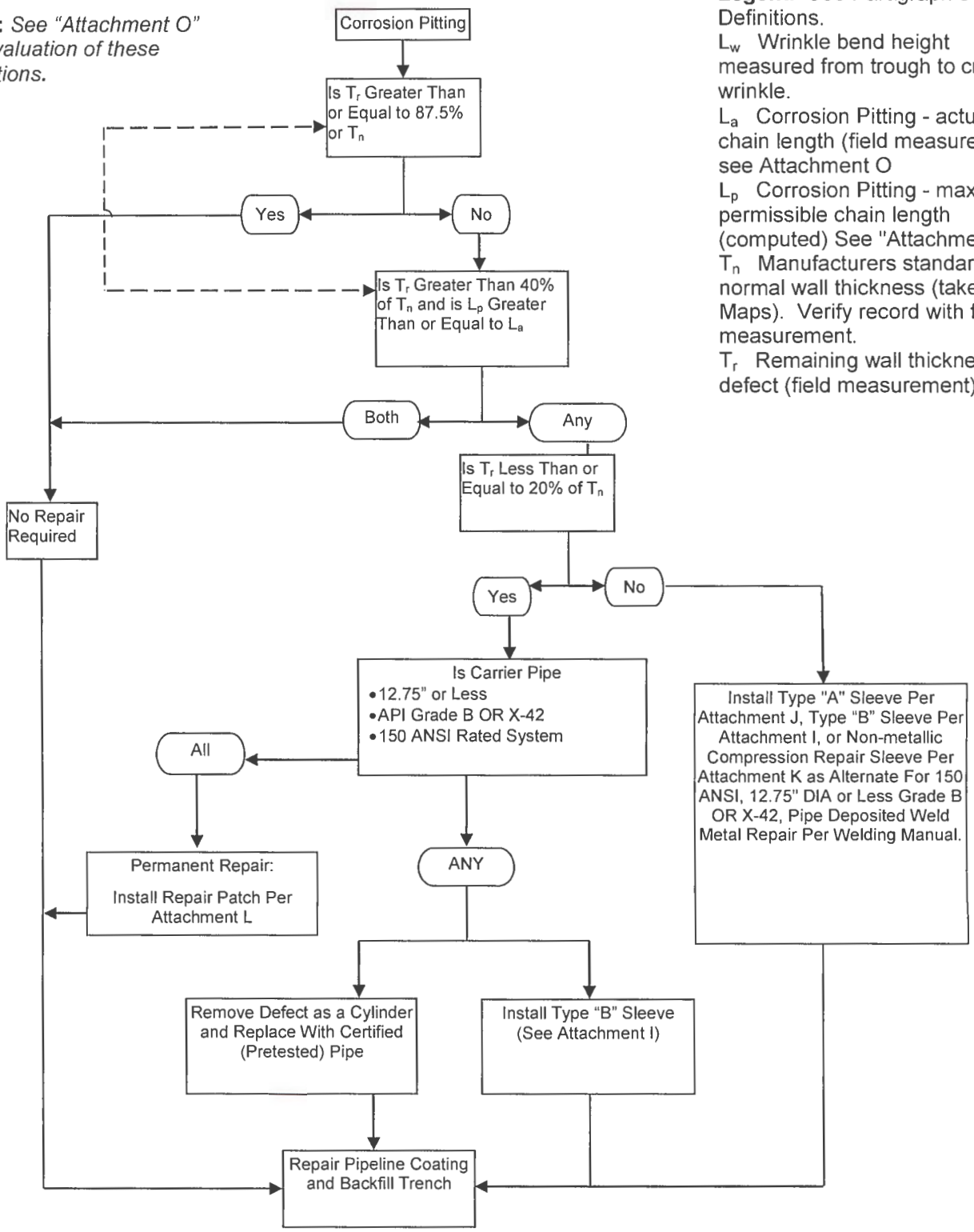
Dent Repair Determination
(Attachment G)



Note: All dents shall be checked with dye penetrant or magnetic particle inspection throughout the entire affected area of the dent to determine if cracks are present. If cracks are present, refer to "Stress Concentrator Repair Determination".

Corrosion Pitting Repair Determination
(Attachment H)

Note: *See "Attachment O" for evaluation of these questions.*



Legend See Paragraph 3 Definitions.

L_w Wrinkle bend height measured from trough to crest of wrinkle.

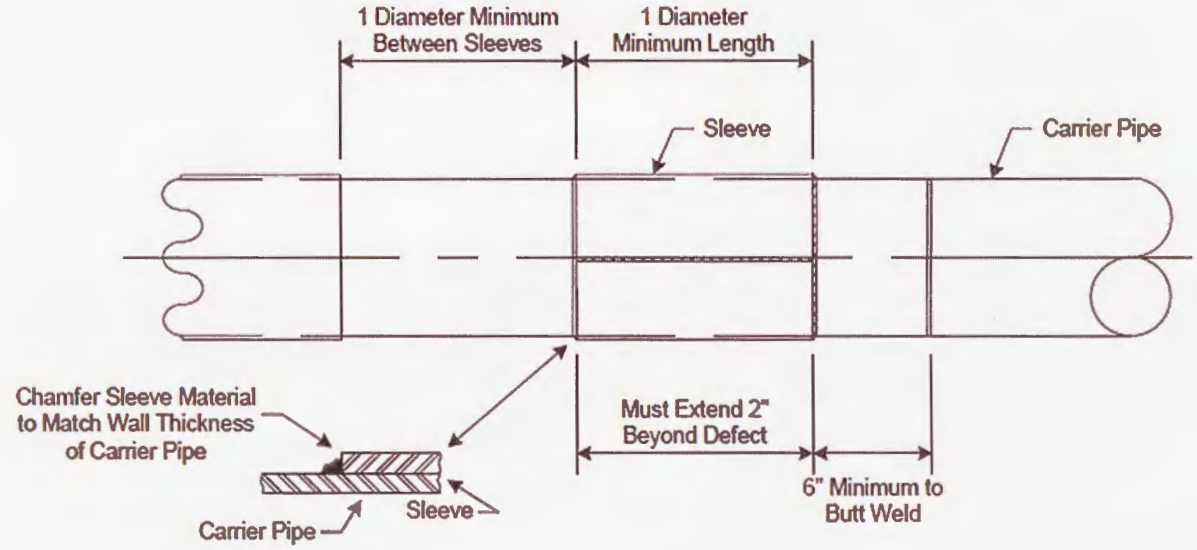
L_a Corrosion Pitting - actual chain length (field measurement) see Attachment O

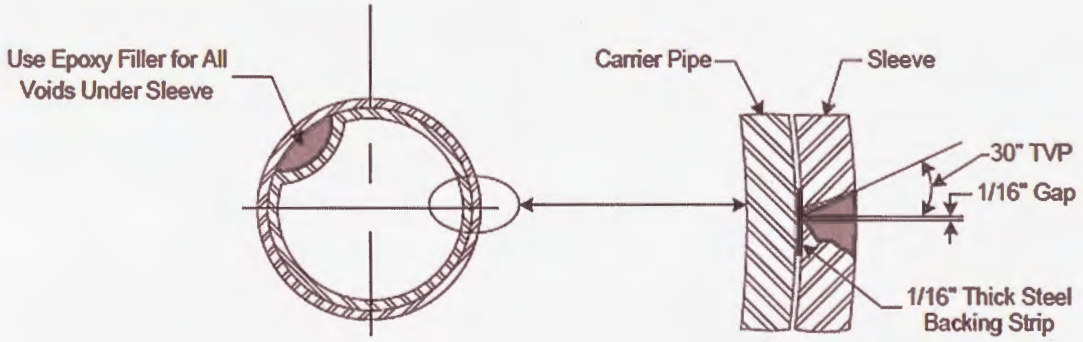
L_p Corrosion Pitting - maximum permissible chain length (computed) See "Attachment P"

T_n Manufacturers standard normal wall thickness (taken from Maps). Verify record with field measurement.

T_r Remaining wall thickness at defect (field measurement)

Type B Repair Sleeve
(Attachment I – Page 1)





(Attachment I – Page 2)

Notes (Type B Repair Sleeve)

Type "B" sleeves may be used as a temporary or permanent repair over dents, corrosion, welds with incomplete penetration, and temporary repair only over stress concentrators.

The installation should follow approved welding procedures as referenced in the Welding Manual for the grade of pipe to be welded on.

The carrier pipe shall be ultrasonically examined to determine that the material is sound and of adequate thickness in the areas to be affected by grinding or welding operations.

If a leaking defect is present, a thorough check shall be made to determine the presence of combustible gas mixture or flammable liquid. Hot work shall only commence when safe conditions are indicated.

Welding procedures regarding shut down shall follow the appropriate weld specifications described in the Chaparral Energy's Welding Manual.

Reference:

- The system should be shut down, with normal line pack, for welding on any grade X-52 pipe that is less than .300 wall thickness (WT).
- The system should be shut down, with normal line pack, for welding on any pre-1965 pipe that is less than .300 WT.
- The system must be drained and inerted prior to welding on any pipe that is less than .200 WT.
- All other pipe greater than .200 WT may continue to be operated at pressures that do not cause the stress in the pipe at the job site to exceed 50% SMYS.

All welding must be inspected visually, according to visual inspection requirements of APCI 1107. Fillet welds must also be inspected for hydrogen-induced cracking, by dye penetrant or magnetic particle testing, a minimum of 12 hours after installation.

Sleeves may be placed over welds but must extend 6 inches past the mainline butt weld on both ends. With the Engineering Department's approval, weld caps can be ground down flush with the exterior of the pipe or a groove may be ground in the interior of the sleeve material.

Sleeves may not be placed over welds on steep slopes (greater than 45 degrees) due to possible tension stresses in the pipeline.

The sleeve material may be formed plate or cut from pipe and must have a design pressure not less than the pipe being repaired.

Visual inspection of the sleeve material shall be conducted to examine for defects such as surface laminations, dents, scratches, gouges, etc. If such conditions are present, the sleeve material shall be discarded.

If electric resistance welded (ERW) pipe is used to fabricate the sleeve material, the ERW seam shall be discarded.

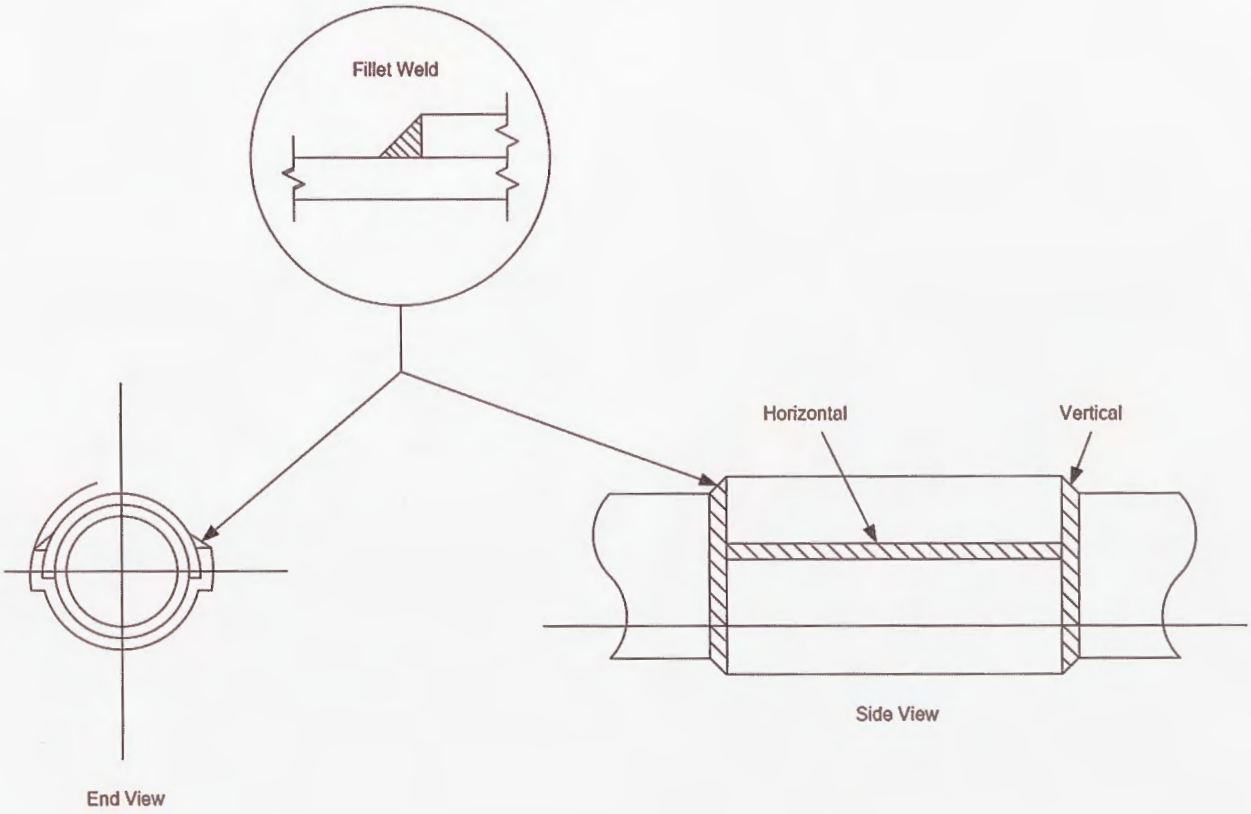
The sleeve material does not need to be hydrostatically tested.

For installation over dents, corrosion, stress concentrators, etc. a filler material such as epoxy should be used to fill the void between the sleeve and the carrier pipe.

The sleeve material must be coated and repairs made, as necessary, to existing coating prior to backfill. If installed on bare pipe, the sleeve and all pipe cleaned for inspection must be coated.

Support and backfill shall follow standard Chaparral Energy's practices.

Joint Design Full Encirclement Sleeve
(Type "B" Manufactured Sleeve with Overlapping Sides)
(Attachment I – Page 3)



Notes (Exhibit S)

A Type "B" manufactured sleeve with overlapping sides may be used as a temporary or permanent repair over dents, corrosion, welds with incomplete penetration, and temporary repair only over stress concentrators **On Pre-1965 Pipe Installed on the Norco System Only.**

The installation should follow approved welding procedures referenced in the Welding Manual. The longitudinal overlap seam is to be welded prior to welding the circumferential seam.

As a general reference:

Grade B and X-42 pipe:

Fillet weld (ends) - 7018 low hydrogen rods, 3 passes or as required

Fillet weld (sides) - 6010 rod, 1st pass

7010 rod, 2nd pass and any additional passes

The carrier pipe shall be ultrasonically examined to determine that the material is sound and of adequate thickness in the areas to be affected by grinding or welding operations.

The minimum wall thickness of the carrier pipe must equal or be greater than .200" at the fillet welds of the sleeve.

If a leaking defect is present, a thorough check shall be made to determine the presence of combustible gas mixture or flammable liquid. Hot work shall only commence when safe conditions are indicated.

Welding procedures regarding shutdown shall follow the appropriate weld specifications described in the Welding Manual.

Reference:

- The system should be shut down, with normal line pack, for welding on any pre-1965 pipe that is less than .300 wall thickness (WT).
- The system must be drained and inerted prior to welding on any pipe that is less than .200 WT.
- Pre-1965 pipe greater than .300 WT may continue to be operated at pressures that do not cause the stress in the pipe at the job site to exceed 50% SMYS.

All welding must be inspected visually, according to visual inspection requirements of API 1104. See Attachment F "Repair Determination for Stress Concentrators in Appurtenance Fillet Welds". Fillet welds must also be inspected for hydrogen-induced cracking, by dye penetrant or magnetic particle testing, a minimum of 12 hours after installation.

Sleeves may be placed over welds but must extend 6 inches past the mainline butt weld on both ends. With the EOR Department approval, weld caps can be ground down flush with the exterior of the pipe or a groove may be ground in the interior of the sleeve material.

Sleeves may not be placed over welds on steep slopes (greater than 45 degrees) due to possible tension stresses in the pipeline.

The sleeve material must have a design pressure not less than the pipe being repaired.

Visual inspection of the sleeve material shall be conducted to examine for defects such as surface laminations, dents, scratches, gouges, etc. If such conditions are present, the sleeve material shall be discarded.

The sleeve material does not need to be hydrostatically tested.

For installation over dents, corrosion, stress concentrators, etc. a filler material such as epoxy should be used to fill the void between the sleeve and the carrier pipe.

The sleeve material must be coated and repairs made, as necessary, to existing coating prior to backfill. If installed on bare pipe, the sleeve and all pipe cleaned for inspection must be coated.

Support and backfill procedures shall follow the Maintenance Manual procedures.

Type A
Repair Sleeve and Repair Procedures
(Attachment J – Page 1)

Cross-Section Type A Sleeve With Side Bar

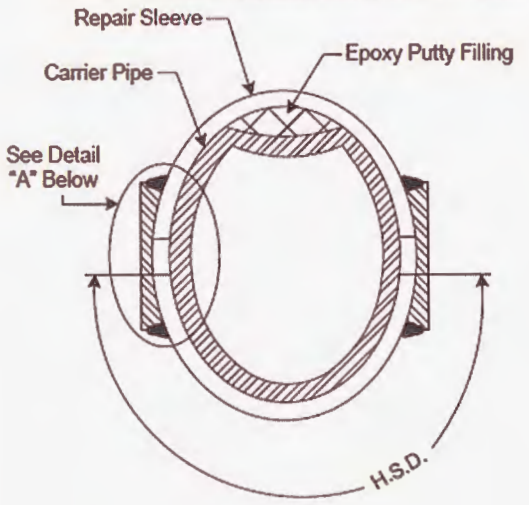
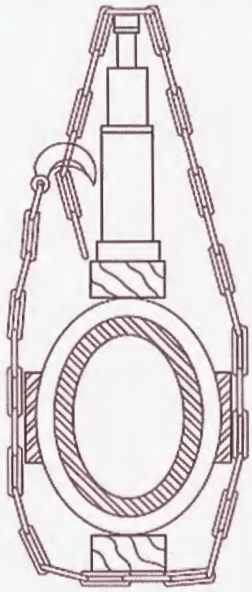
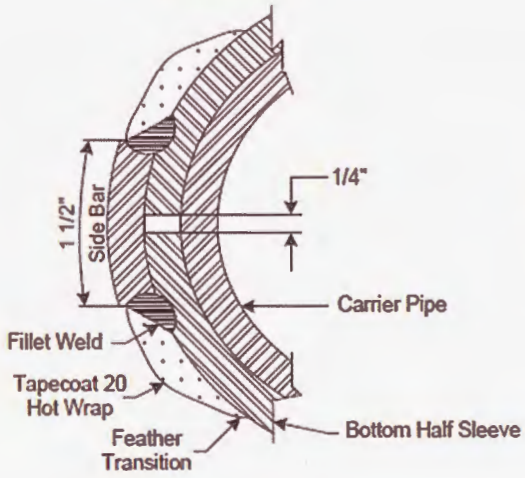


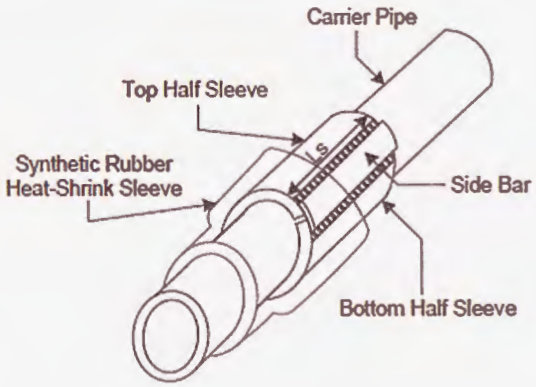
Illustration For Sleeve Alignment Using Binders



Detail "A"



Isometric View



Fabrication and Installation of the Repair Sleeve

(Attachment J – Page 2)

1. Obtain ASTM A-36 Steel Plate or API-STD. 5L Line Pipe (seamless or E.R.W.) of known diameter, wall thickness and grade, the strength of the selected material shall be equal to or greater than the carrier pipe to which the sleeve is to be installed. Wall thickness and grade of the plate or line pipe can exceed that of the carrier pipe. In any case, sleeve wall thickness selection shall not be less than 0.250" or greater than 0.500".
2. The repair sleeve length shall be greater than or equal to the lenth of the defect plues two (2) inches at each end, but not less than a total length of 1 nominal pipe diameter.
3. From the line pipe, cut two (2) cylinders each to the required sleeve length
4. Equation to determine approximate outside circumferential dimension (HSD) for each half of reinforcement sleeve to be fabricated is as follows:

   $$H.S.D. = \left[\left(\frac{D}{2} + Tp\right) \times 3.14\right] - 0.125$$

   Where: H.S.D. = Half Sleeve Dimension (IN.)

   D = Outside pipe diameter of carrier pipe (IN.)

   Tp = Wall thickness of repair sleeve (IN.)

   Note: If E.R.W. line pipe is selected, locate the longitudinal seam in the discarded or cut-away section of the cylinder.
5. Fabricate two (2) side bar straps from surplus sleeve material to size as shown in detail "A" and make strap fillet weld to bottom half of sleeve prior to installation of half sleeves and use of binder clamps.
6. Prior to sleeve assembly on the carrier pipe, have the control center limit the pressure at the job site to a level that does not cause the stress in the pipe at the kob to exceed 50% SMYS.
7. At start of assembly, mix epoxy putty and place enough putty into the defect area so that there will be a slight excess squeezed from the area when the two half sleeves are jacked into place.
8. Place half sleeves over the defect area and move into place using clamps or jacks and chain binders per illustration on this page.
9. Welds shall be made in accordance with procedures located in the welding manual.

   Note: Do not weld the repair sleeve ends.
10. After the sleeve has been installed, all exposed steel must be wire brushed so that all scale, oxidation and dirt are cleaned from these surfaces.
11. Apply to primecoat M6 to the side bar, areas adjacent to the side bars and carrier piping adjacent to the ends of the sleeve.
12. Apply tapecoat 20 (Hot Wrap) along the edge of each side bar and at each end of the sleeve (see Detail A). This wrap will function as a filler material and coating for these particular areas. More than one layer of wrap may be necessary to provide a smooth feather transition for the shrink sleeve.
13. Install heat shrink sleeves over each end of the repair sleeve providing a minimum of 1 ½ Inch overlap in the center of the sleeve.
14. If the repair sleeve is longer than 2.4", the center section of the repair sleeve must be wrapped with tapecoat 20 prior to installation of the heat shrink sleeves.
15. If excessive coating has been removed from the carrier pipe, the carrier pipe should be recoated so that a minimum of 1 ½" overlap is achieved where the shrink sleeve covers the new wrap material.

Non-Metallic Compression Repair Sleeve Procedures

(Attachment K – Page 1)

Types of Repairable Defects

Non-metallic compression repair sleeves are permitted for repairs on defects occurring on:

- Straight pipe
- Bends with a radius of 3D or greater. Non-metallic compression repair sleeves may be cut to 6-inch lengths to better fit on bends.
- At a girth weld.

Non-metallic compression repair sleeves may be used for permanent repair of external metal loss defects less than 80 percent of the nominal wall thickness.

Non-metallic compression repair sleeves may be used for permanent repair of plain dents provided epoxy filler is installed in the dent recess.

The defect area shall not have sharp edges. Stress concentrators shall be removed prior to applying a non-metallic compression repair sleeve as a permanent repair.

Non-metallic compression repair sleeves **may not be used** to permanently repair defects with a wall loss greater than 80 percent of the nominal wall thickness of the pipe. They may be used for temporary repairs until a cutout can be scheduled.

Composites shall not be used if cracks or crack-like defects are present. If cracks or crack-like defects are removed, composites may be used for permanent repairs in accordance with manufacturers specifications. Composites may be used for temporary repairs for defects until a cutout or other approved permanent repair can be scheduled and completed.

The following are approved non-metallic compression repair sleeves:

- Clock Spring
- Armor Plate
- Black Diamond Wrap

Clock Spring Storage and Installation

Storage

The non-metallic compression repair sleeve wrap may be stored in warehouse conditions.

The adhesive, activator, and filler should be stored in a temperature-controlled environment. These components have a shelf life of approximately one year and should be checked for expiration before use. Replacement adhesive and filler may be ordered separately.

Pipeline Operating Conditions

The operating pressure shall be reduced as prescribed in the Operating and Maintenance Manual during the installation of the repair sleeve, including the cure time for the resin wrap (between two hours and eight hours, depending on ambient temperature and application of heat).

Installation Temperature

Installation temperature must be between 0 and 120°F. Cure time may be extended at temperatures below 40°F.

Preparation/Cleaning of Carrier Pipe

The non-metallic compression repair sleeve may be applied in diverse weather conditions (cold weather, high humidity, etc.), but the installation area is to be protected (tented) from inclement conditions whenever possible.

All pipe coatings containing "coal tar" or "zinc" **must** be completely removed from the repair area. Coal-tar residue and the presence of zinc inhibits the curing and bonding properties of the adhesive.

Note:

- To test for the presence of coal tar or zinc, apply a small sample of "mixed" adhesive to the area in question. If coal tar or zinc is present, the adhesive will turn from blue to green.
- Remove all thick film coating and sand blast pipe to clean metal.
- Thin film fusion bond epoxy coatings in good condition may be left intact.
- An anchor pattern is required for pipe surface preparation prior to a non-metallic compression repair sleeve installation. Cleanliness required shall meet the standard of NACE #3 finish or equivalent.
- Do not use tools with a galvanized coating. The galvanized coating will inhibit the proper curing characteristics of the adhesive.
- Do not use solvents other than acetone or MEK (methyl ethyl ketone) during pipe surface preparation and/or ancillary cleaning of the Clock Spring.

Warning:

- Acetone and MEK are highly flammable liquids. Careful handling is required. Be sure to follow guidelines in the Material Safety Data Sheets.

Installation

Non-metallic compression repair sleeves must be applied by qualified installers.

- Installers are qualified only upon completion of training and certification in the installation procedures.
- Install Clock Spring according to instructions furnished with kit.

Armor Plate Storage and Installation

Storage

- The Armor Plate may be stored in warehouse conditions above 60°F. At least 24 hours prior to use, Armor Plate components should be stored between 75 and 90°F.
- The components should be stored in a dry, cool place (temperature-controlled environment). These components have a shelf life of approximately two years and should be checked for expiration before use. Armor Plate, Inc. should be contacted for use after two years. Replacement components may be ordered separately.

Pipeline Operating Conditions

- The operating pressure shall be reduced as prescribed in the Operating and Maintenance Manual during the installation of the repair sleeve, including the cure time for the resin wrap (between two hours and eight hours, depending on ambient temperature and application of heat).

Installation Temperature

- Installation temperature of the pipe may be between -50 and 200°F. If the outdoor ambient temperature is below 60°F, the repair site must be heated using heat blankets directly on the newly installed product. Heat greatly affects cure time of the product (see manufacturers product specification).

Preparation/Cleaning of Carrier Pipe

The Armor Plate may be applied in diverse weather conditions (underwater, cold weather, high humidity, etc). It is not necessary to protect the pipe from weather during installation.

The pipe surface must be free from foreign matter including FBE, CTE, oil, grease, dirt, debris, and rust. An Anchor pattern must be established on the surface.

Remove all thick film coating and sand blast pipe to clean metal. Call Armor Plate if coating cannot be sandblasted or ground clean. Some coating left intact may require a surface pattern to be established. Then solvent wipe the surface.

An anchor pattern is required for pipe surface preparation prior to Armor Plate installation. Cleanliness required shall meet the standard of NACE #3 finish or equivalent. See instructions with the Armor Plate Kit.

Do not use solvents other than acetone or MEK (methyl ethyl ketone) during pipe surface preparation and/or ancillary cleaning of the Armor Plate. Do not use oil based solvents.

Warning:

- Acetone and MEK are highly flammable liquids. Careful handling is required. Be sure to follow guidelines in the Material Safety Data Sheets.

Installation

Armor Plate must be applied by qualified installers.

- Installers are qualified only upon completion of training and certification in the installation procedures by Armor Plate, Inc. or by a trainer certified by Armor Plate, Inc. Those already certified to install Clock Spring may be easily qualified by Armor Plate, Inc.
- Install the Armor Plate wrap according to the instructions and guidelines furnished with Armor Plate Kit.
- The Armor Plate wrap may be coated with most standard types of coating once the surface is tacky to the touch (usually after the recommended cure time of 2 to 8 hours).
- Pipe coatings for **above-ground pipe** must be coated as per company procedures. Armor Plate; however, contains inhibiters for UV protection and is not ultraviolet sensitive.

Black Diamond Wrap Storage and Installation

Storage

- Black Diamond Wrap and components may be stored in warehouse conditions above 32°F and below 130°F. At least 12 hours before installation, Black Diamond Wrap and components should be stored between 70 and 90°F.
- Shelf Life is one-year from purchase date.

Pipeline Operating Conditions

- The operating pressure shall be reduced as prescribed in the Operating and Maintenance Manual during the installation of the repair sleeve, including the cure time for the resin wrap (between two hours and eight hours, depending on ambient temperature and application of heat).

Installation Temperature

- The minimum recommended curing temperature for both the standard epoxy and the low temperature epoxy is 40°F. Both epoxies will cure at temperatures between 0°F and 40°F, however, cure times will be greater than 24 hours. External heating in cold weather and cooling in hot weather will allow for greater control of cure time. NOTE: The ambient temperature will have an effect on both Pot Life and Cure Time. Refer to manufacturer's instructions.
- The low temperature epoxy at 40°F will cure in three to four hours rather than 10 hours for the standard epoxy.

Preparation/Cleaning of Carrier Pipe

- Black Diamond Wrap may be applied in adverse weather conditions (underwater using a special epoxy, cold weather using low temperature epoxy, high humidity, etc). Tenting under severe conditions is recommended.
- The pipe surface must be cleaned of all foreign matter including coating materials, oil, grease, dirt, debris, and rust. When removing old coating, refer to SA C-10 (Asbestos-Containing Materials). An anchor pattern must be established on the pipe surface.
- Blast clean the pipe surface to a NACE #3 (Commercial Blast Clean). An alternative is Power Tool Cleaning to a SSPC-SP-3 equivalent. A rough profile is desired for the epoxy bond.

Do not use solvents other than acetone or MEK (methyl ethyl ketone) during pipe surface preparation and/or ancillary cleaning of the Black Diamond Wrap installation components or tools. Do not use oil based solvents.

Warning:

- Acetone and MEK are highly flammable liquids. Careful handling is required. Be sure to follow guidelines in the Material Safety Data Sheets and to properly clean up all residual.

Installation

- Black Diamond Wrap must be installed by qualified installers.
- Installers are qualified only after completion of Training and Certification in the installation procedures by T.D.Williamson or by a Trainer Certified by T.D.Williamson.
- Install Black Diamond Wrap in accordance with the installation instructions and guidelines provided by T.W.Williamson.
- Black Diamond Wrap may be over coated with most standard types of pipe coatings once it has cured, usually two to eight hours depending on ambient temperature conditions.
- Pipe coatings used in above-grade applications must be UV resistant.

After Installation

- After installation, recoat the pipeline using the following procedure:
- The non-metallic compression repair sleeve adhesive must attain a minimum hardness of 40 durometer on the Shore "A" Hardness Scale prior to applying any isolation pipe coating material (cannot be dented by a fingernail).
- **The non-metallic compression repair sleeve must be removed if the minimum hardness is <u>not</u> attained.**
    - **Note**: Coal tar may be used as a pipe coating **after** the non-metallic repair sleeve adhesive has attained full cure.
- Pipe coatings for **above-ground pipe** must be opaque. The non-metallic compression repair sleeve is UV-sensitive.
- Place a magnet at the 12:00, 3:00, 6:00 and 9:00 position at each end of the non-metallic compression repair sleeve to create an easy signature to identify on the smart pig run log. The magnets to use are 1" in diameter and 3/16" thick and can be purchased from McMaster-Carr (see information below). The magnets should be placed directly on the pipe after primer has been applied and then coated as required.

Magnet Information

Material - Bonded Ferrite

Round Disc Type - 1" Diameter x 3/16" thick

Multiple Design - Multiple North and South poles on one side of the magnet

Magnetic Strength - Low to Medium

Resistance to Demagnetization - High

Corrosion Resistance - High

Max. Temp. - 160°

Machinability - Excellent

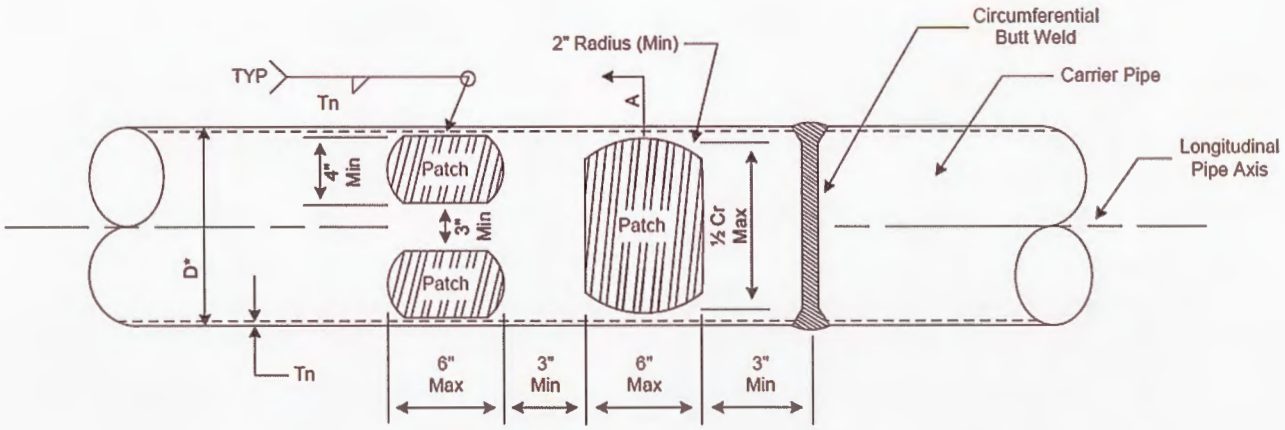
Pull - 10 lbs./lin. ft.

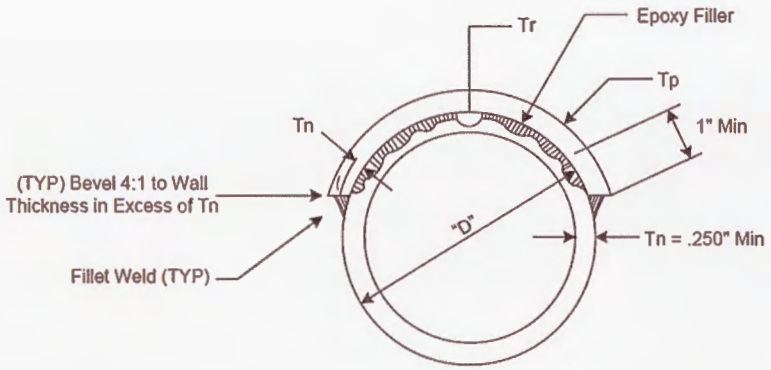
Color - Brown

High Energy Magnetic Shapes - McMaster-Carr #58145K85

Weld-On Patch

(Attachment L – Page 1)





Legend

D = Nominal Outside Diameter
Tn = Nominal Wall Thickness
Tr = Remaining Wall Thickness
Tp = Wall Thickness of Patch
Cr = Pipe Circumference

Patch Repair is permitted when all of the following conditions are met:

1. "D" less than or equal to 12.75" Diameter
2. Carrier pipe shall be API STD. 5LX-Grade 42

   (Sy = 42,000 PSI) API STD. 5L-Grade B

   (Sy = 35,000 PSI) or API STD. 5L-Grade A

   (Sy = 30,000)
3. Hoop stress calculated from design maximum operating pressure (P d) shall not exceed 20% of SMYS (Specific minimum yield strength)

   $$\% \text{ SMYS} = \frac{\text{Pd D}}{\text{2 Tn Sy}} \text{ X } 100 = \_\_.\_\%$$
4. Tp greater than or equal to Tn
5. Patch material grade shall be greater than or equal to carrier pipe grade, but not more than grade X-42
6. Tr less than 87.5% of Tn (Between 87.5% and 20% of Tn, installation of a type "A" repair sleeve is the preferred repair)
7. Tn shall be greater than or equal to 0.250"

Plidco Split-Sleeve

(Attachment M)

Manufacturer's Information

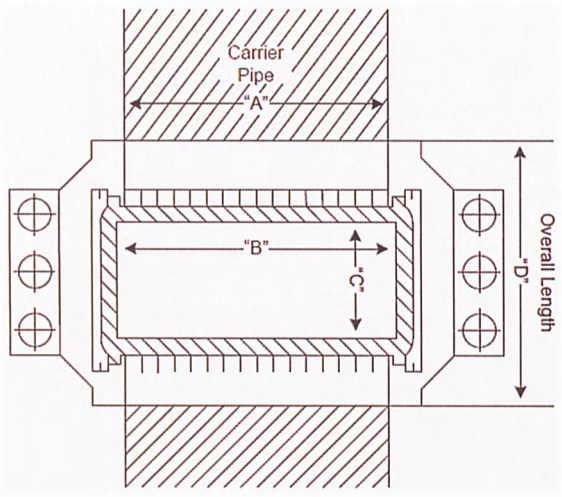
All-steel Plidco Split-Sleeves are widely used for permanently repairing pipelines, including oil, water, gas, steam and chemical process.

Repeated tests, in both laboratories and field, prove that the Plidco Split-Sleeves withstand a shell test of three times or more he recommended maximum working pressure of 1000 psi.

Plidco Split-Sleeves are lighter in weight than ordinary repair fittings, require far fewer bolts and are quickly and easily installed.

Patented GirderRings hold factory installed gaskets in place. These GirderRings prevent erosion or displacement by leaking fluid during installation.

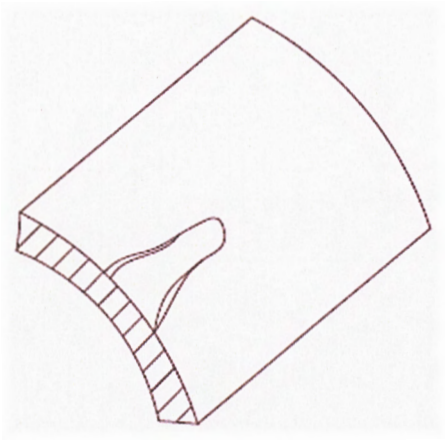
When a Plidco Split-Sleeve is bolted in place, the seal is complete and no further operation is necessary. Sleeve seals are available in Viton. Sleeve lengths longer than standard lengths are also available.



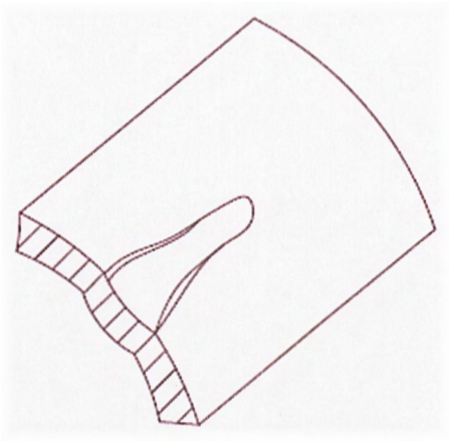
Plidco Split-Sleeve Specifications					
"A" Nominal Pipe Size	"B" Inside Diameter Inches	"C" Inside Length Inches	"D" Standard Length Inches	Suggested Maximum Working Pressure	Shipping Weight Pounds
1 1/2"	2 3/8	5 1/4	8 1/2	1000	22
2"	2 7/8	5 1/4	8 1/2	1000	29
2 1/2"	3 3/8	5 1/4	8 1/2	1000	32
3"	4	5 1/4	8 1/2	1000	35
4"	5	5 1/4	8 1/2	1000	37
5"	6 1/16	5 1/4	9	1000	46
6"	7 1/8	5 1/4	9	1000	58
7"	7 1/2	5 1/4	10	1000	90
8"	9 1/8	5 1/4	10	1000	114
10"	11 1/4	5 1/2	10 1/2	1000	143
12"	13 1/4	5 1/2	10 1/2	1000	181
14"	14 1/2	8	14	1000	292
16"	16 1/2	8	14	1000	335
18"	18 1/2	8	14	1000	360
20"	20 1/2	8	14	1000	500
22"	22 1/2	8	14	1000	511
24"	24 1/2	8	14	1000	602
26"	26 1/2	8	14	1000	760
30"	30 1/2	8	14	1000	836
32"	32 1/2	8	14	1000	1175
34"	34 1/2	8	14	1000	1250
36"	36 1/2	8	14	1000	1455
40"	40 1/2	8	14	1000	1465
42"	42 1/2	8	14	1000	1510
48"	48 1/2	8	14	1000	1800

External Pipeline Defect Illustrations

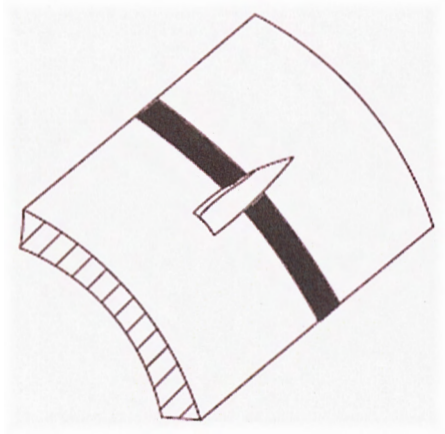
(Attachment N – Page 1)



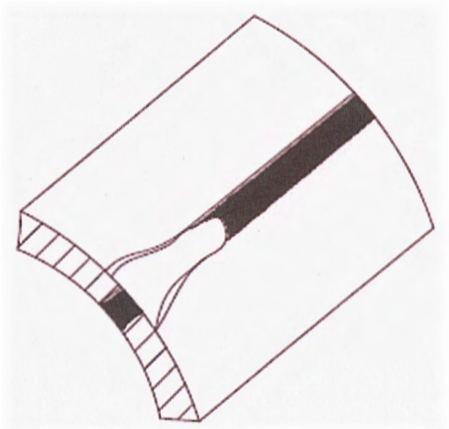
Detail 5
Gouge or Scratch



Detail 4
Gouge or Scratch in Dent

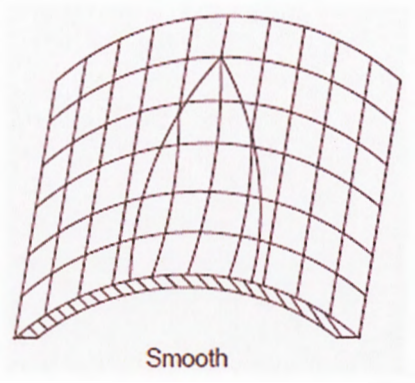


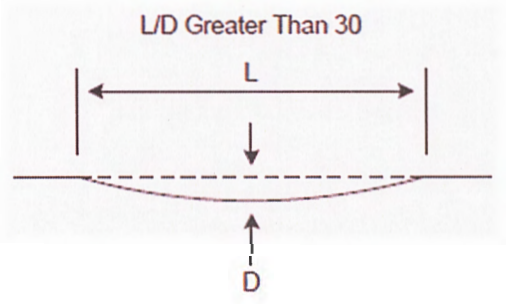
Detail 6
Gouge or Scratch in Girth Weld

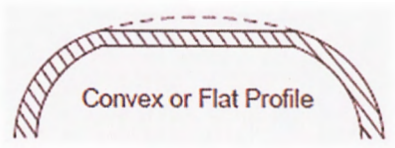


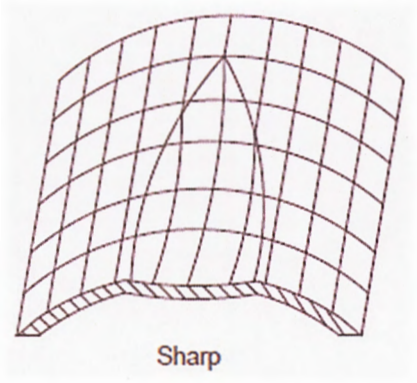
Detail 7
Gouge or Scratch in Longitudinal Weld

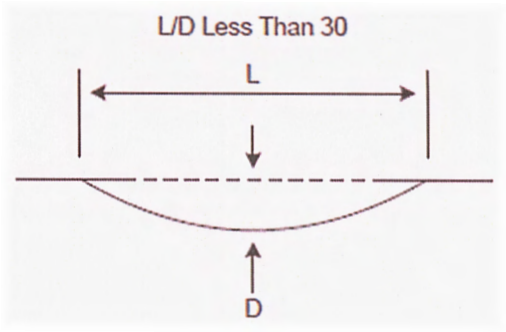
Plain Dents

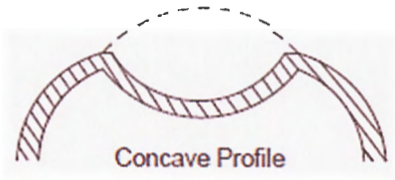

Smooth


L/D Greater Than 30
L
D


Convex or Flat Profile

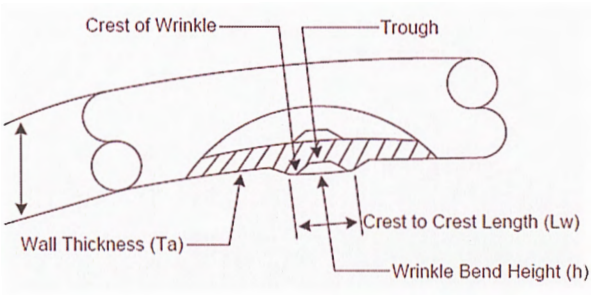

Sharp


L/D Less Than 30
L
D


Concave Profile

Wrinkle Bends

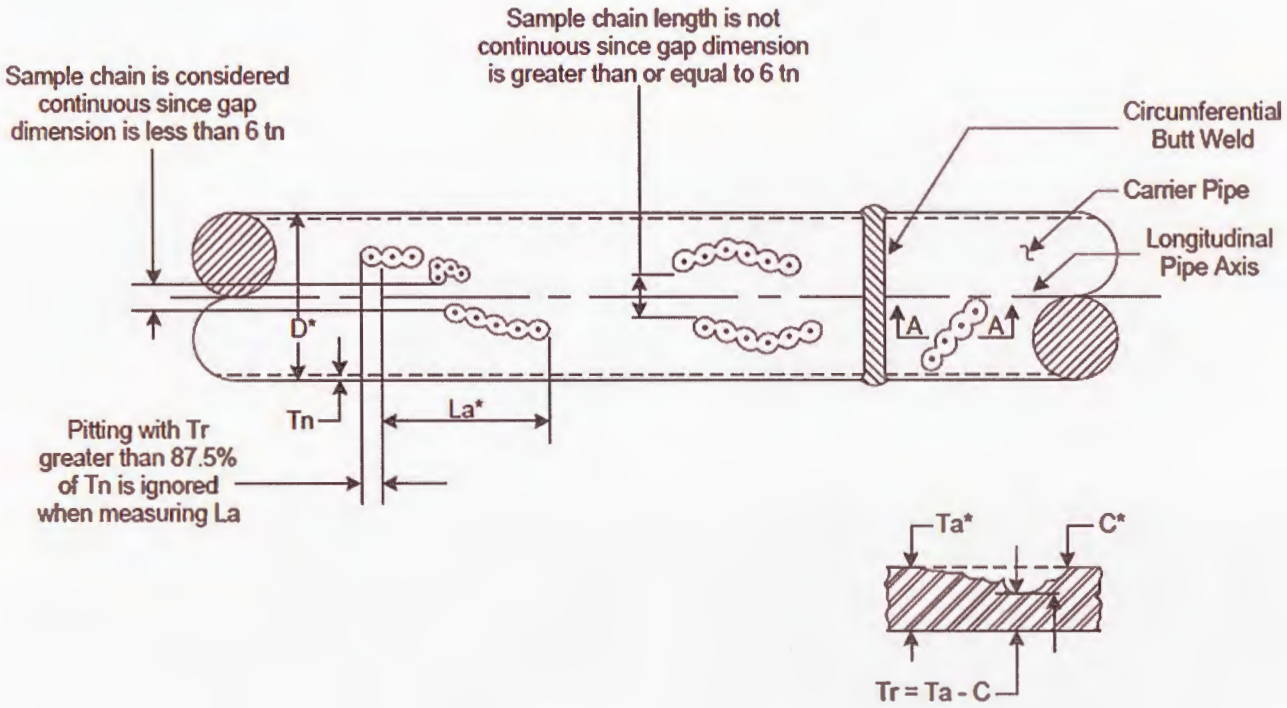
(Attachment N – Page 3)



Corrosion Chain Length Analysis

Type I Interaction

(Attachment O – Page 1)



Legend

* = Field Measurments

D = Nominal Outside Diameter

Tn = Nominal Wall Thickness

Ta = Actual Wall Thickness

Tr = Remaining Wall Thickness

C = Maximum Depth at Corroded Area

La = Actual Chain Length (longitudinal extent of the corroded area) as measured along the pipe axis only for areas where Tr is less that 87.5 of Tn
Note: Chain length applies to longitudinal measurements only.

Lp = Calculated Permissible Chain Length

Calculate the following and solve for (Lp)

B = Calculated Value Not to Exceed 4.0

$$\sqrt{\left[\left(\frac{C/Tn}{(1.1\ C/Tn) - 0.15}\right)^2\right]} - 1 = \_.\_\_$$

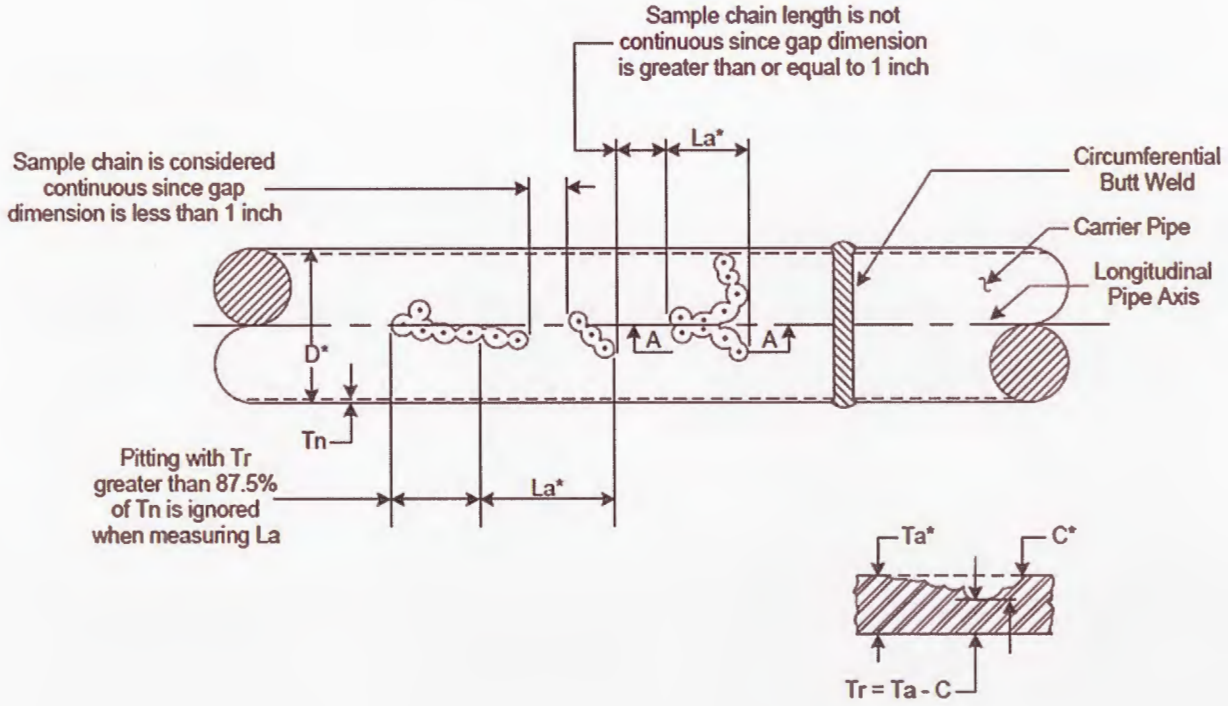
$$Lp = 1.12\ B\sqrt{D\ Tn\ Lp} = \_.\_\_$$

La = Actual Chain Length La = _._ _

Corrosion Chain Length Analysis

Type II Interaction

(Attachment O – Page 2)



Legend

* = Field Measurments

D = Nominal Outside Diameter

Tn = Nominal Wall Thickness

Ta = Actual Wall Thickness

Tr = Remaining Wall Thickness

C = Maximum Depth at Corroded Area

La = Actual Chain Length (longitudinal extent of the corroded area) as measured along the pipe axis only for areas where Tr is less that 87.5 of Tn
Note: Chain length applies to longitudinal measurements only.

Lp = Calculated Permissible Chain Length

Calculate the following and solve for (Lp)

B = Calculated Value Not to Exceed 4.0

$$\sqrt{\left[\left(\frac{C/Tn}{(1.1\ C/Tn) - 0.15}\right)^2\right] - 1} = \_.\_\_$$

$$Lp = 1.12\ B\sqrt{D\ Tn\ Lp} = \_.\_\_$$

La = Actual Chain Length La = _.__

(Attachment O – Page 3)

Notes:

- Equation (L_p) developed by Battelle Research Laboratories to predict strength of pipe at corroded areas as an expression of length and depth. Exhibit P (Values of Maximum Permissible Chain Length) may be used to determine L_p instead of solving the equation for Lp.
- Corrosion length relationship ($L_{p \text{ and } L_a)}$ relative to pipe strength applicable only when T_r is between 20% and 87.5% of T_n.
- For $L_{a \text{ to }} L_p$ comparison and corresponding repair selection, refer to Exhibit C1 (Corrosion Pitting Repair Determination.

Reference:

ANSI B31.4 (Current Edition)

"Liquid Petroleum Transportation Piping Systems"

Section 451.6.2

ANSI/ASME B31G (Current Edition)

Manual for Determining the Remaining Strength of Corroded Pipelines

DOT Part 195, Title 49

(Amended 9/17/84 in Federal Register Vol. 49, No. 181)

"Transportation of Hazardous Liquids by Pipeline: Isolated Corrosion Pitting"

Battelle Research Laboratories

Paper "Summary of Research to Determine the Strength of Corroded Areas in Line Pipe"

By: J.P. Kiefner & A. R. Duffy 7/20/71.

Attachment P – Values of Maximum Permissible Chain Length

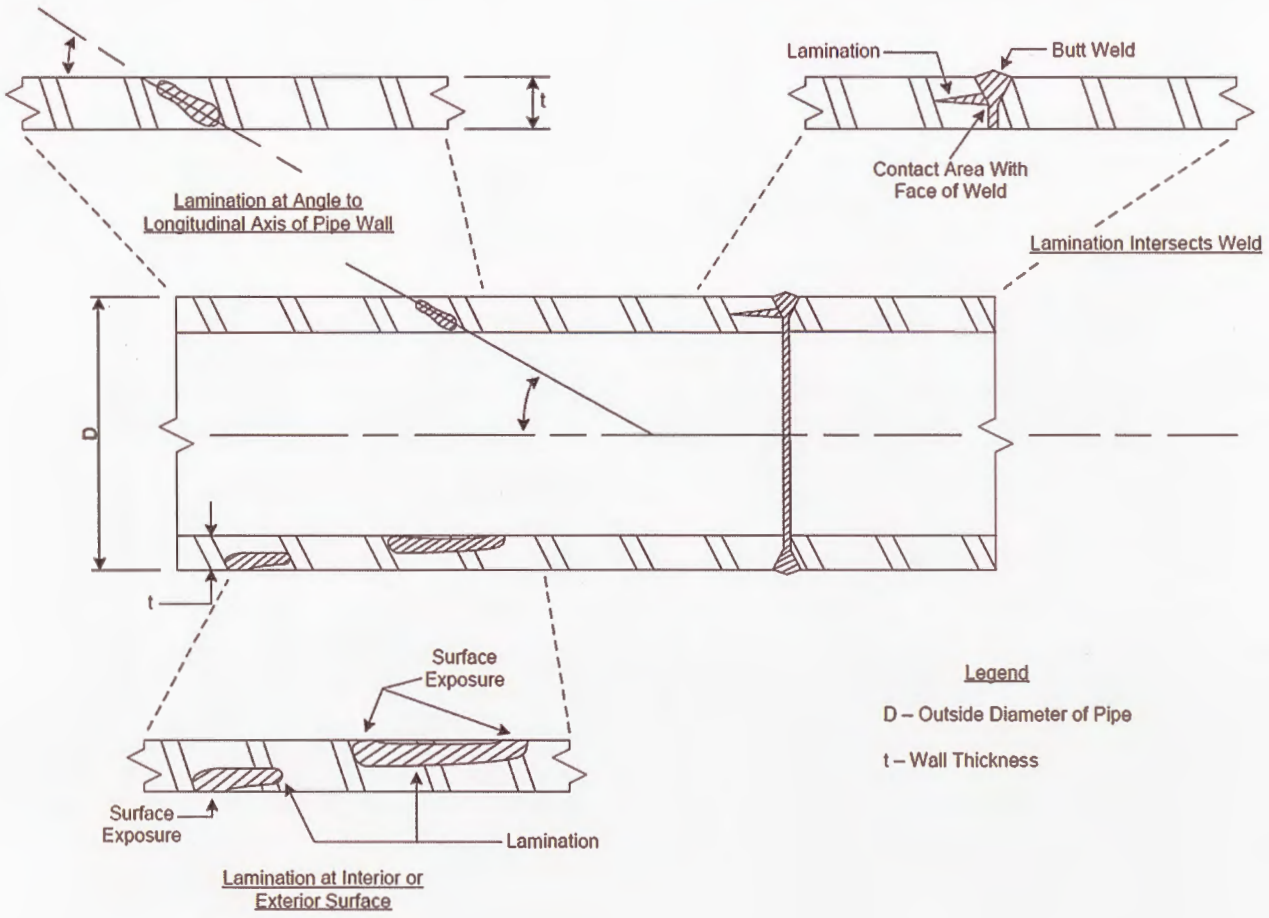
Values of Maximum Lp (inches) for Piping with Outside Diameter of 6.625				
	Nomimal Wall Thickness (Tn), inches			
Maximum Pit Depth	0.188	0.219	0.250	0.280
0.010				
0.020	5			
0.030	5	5 5/8	5 5/8	6 1/8
0.040	2 13/16	4 5/8	5 5/8	6 1/8
0.050	1 13/16	2 5/8	7 1/8	5 11/16
0.060	1 5/16	2 1/16	2 11/16	3 1/2
0.070	1 5/16	1 11/16	2 1/8	2 5/8
0.080	1 1/8	1 1/16	1 5/8	2 5/16
0.090	1	1 1/4	1 5/16	1 1/8
0.100	1/8	1 1/8	1 1/8	1 5/8
0.110	15/16	1	1 1/4	1 1/2
0.120		15/16	1 1/8	1 5/8
0.130		1/8	1 1/16	1 1/4
0.140			15/16	1 1/8
0.150			1/8	1 1/16
0.160				1/8
0.170				15/16

Values of Maximum Lp (inches) for Piping with Outside Diameter of 8.625					
	Nomimal Wall Thickness (Tn), inches				
Maximum Pit Depth	0.203	0.219	0.277	0.322	0.500
0.010					
0.020					
0.030	5 15/16	6 5/16	6 13/16		
0.040	4 1/8	5 5/16	6 13/16	7 1/16	
0.050	2 5/8	3 1/8	6 5/16	7 1/16	
0.060	2	2 5/16	3 1/8	6 1/16	9 5/16
0.070	1 11/16	1 1/8	2 15/16	4 1/8	9 5/16
0.080	1 1/16	1 5/8	2 1/16	3 1/4	9 5/16
0.090	1 1/4	1 1/16	2 1/16	2 5/8	8 5/8
0.100	1 1/8	1 1/4	1 15/16	2 5/8	6 1/4
0.110	1	1 1/8	1 11/16	2 1/8	5 1/16
0.120	15/16	1 1/16	1 1/2	1 15/16	4 5/16
0.130		15/16	1 3/8	1 5/8	3 11/16
0.140			1 5/16	1 5/8	3 5/8
0.150			1 5/16	1 1/2	3 1/8
0.160			1 1/8	1 1/16	2 7/8
0.170			1 1/16	1 5/16	2 5/8
0.180			1	1 1/4	2 1/2
0.190				1	2 5/16
0.200					2 1/16
0.210					2 1/8
0.220					2
0.230					1 7/8
0.240					1 13/16
0.250					1 5/8
0.260					1 11/16
0.270					1 5/8
0.280					1 1/16
0.290					1 1/2
0.300					1 1/16

Values of Maximum Lp (inches) for Piping with Outside Diameter of 10.75							
	Nominal Wall Thickness (Tn), inches						
Maximum Pit Depth	0.203	0.219	0.250	0.279	0.307	0.365	0.500
0.010							
0.020							
0.030	6 7/8	6 7/8	7 7/8	7 7/8			
0.040	4 7/8	5 9/16	7 7/8	7 7/8	8 7/8	8 7/8	
0.050	2 7/16	3 1/2	4 7/16	7 7/8	8 7/8	8 7/8	
0.060	2 1/4	2 7/16	3 7/8	4 7/16	5 3/4	8 7/8	10 7/8
0.070	1 7/8	2 7/8	2 7/16	3 7/16	4 7/8	6 7/8	10 7/8
0.080	1 7/8	1 7/16	2 1/4	2 1/4	3 7/16	4 7/8	10 7/8
0.090	1 7/16	1 7/16	1 7/16	2 7/8	2 7/16	3 7/16	9 7/8
0.100	1 1/4	1 7/16	1 1/4	2 7/16	2 7/16	3 7/8	6 7/16
0.110	1 7/8	1 7/16	1 7/16	1 7/8	2 7/16	2 7/16	5 7/8
0.120	1 7/16	1 7/16	1 7/16	1 7/16	2	2 7/8	4 7/16
0.130		1 7/16	1 7/16	1 7/16	1 7/16	2 7/8	4 1/4
0.140			1 1/4	1 7/16	1 7/16	2 7/16	3 7/16
0.150			1 7/8	1 7/8	1 7/16	2 7/16	3 7/16
0.160				1 1/4	1 7/16	1 7/16	3 7/16
0.170				1 7/16	1 7/8	1 7/16	3 7/16
0.180					1 7/16	1 7/16	2 1/4
0.190					1 1/4	1 7/8	2 7/8
0.200						1 7/8	2 7/16
0.210						1 7/16	2 7/16
0.220						1 7/8	2 1/4
0.230							2 7/8
0.240							2 7/16
0.250							1 7/16
0.260							1 7/8
0.270							1 7/16
0.280							1 7/8
0.290							1 7/16
0.300							1 7/8

Values of Maximum Lp (inches) for Piping with Outside Diameter of 10.75								
	Nominal Wall Thickness (Tn), inches							
Maximum Pit Depth	0.219	0.250	0.281	0.312	0.344	0.375	0.405	0.500
0.010								
0.020								
0.030	7 1/2	8	8 1/2					
0.040	6 7/16	8	8 1/2	8 7/16	9 7/8	9 7/16		
0.050	3 7/16	5 7/8	8	8 7/16	9 7/8	9 7/16	10 7/16	
0.060	2 7/16	3 7/16	4 7/8	6 7/8	9 7/8	9 7/16	10 7/16	11 7/16
0.070	2 7/16	2 7/16	3 7/16	4 7/16	6	7 7/8	10 7/16	11 7/16
0.080	1 7/16	2 7/16	3	3 7/16	4 7/16	5 7/16	7 7/16	11 7/16
0.090	1 1/4	2 7/8	2 7/8	3 7/8	3 7/16	4 7/16	5 7/16	10 1/4
0.100	1 7/16	1 7/8	2 7/16	2 1/4	3 1/4	3 7/16	4 1/2	7 7/16
0.110	1 7/8	1 7/16	2 7/16	2 7/16	2 7/8	3 7/8	3 7/16	6 7/8
0.120	1 1/4	1 7/16	1 7/8	2 7/16	2 7/8	3	3 7/16	5 1/4
0.130	1 7/16	1 7/16	1 1/4	2	2 7/8	2 7/16	3 7/8	4 7/8
0.140		1 7/16	1 7/8	1 7/8	2 7/16	2 1/2	2 7/8	4 7/8
0.150		1 1/4	1 1/2	1 1/4	2	2 7/16	2 7/8	3 1/4
0.160			1 7/8	1 7/8	1 7/8	2 7/16	2 7/16	3 1/2
0.170			1 7/16	1 7/16	1 1/4	2 7/16	2 7/16	3 1/4
0.180				1 7/16	1 7/16	1 7/16	2 7/16	3
0.190				1 7/8	1 7/16	1 7/16	2 7/16	2 7/16
0.200					1 1/2	1 7/16	1 7/16	2 7/16
0.210					1 7/16	1 7/8	1 7/8	2 7/16
0.220						1 7/16	1 1/4	2 7/16
0.230						1 1/2	1 7/16	2 7/16
0.240							1 7/8	2 7/16
0.250								2 7/8
0.260								2 7/16
0.270								1 7/16
0.280								1 7/8
0.290								1 7/16
0.300								1 1/4

Defective Lamination Illustrations


Lamination
Butt Weld
Contact Area With
Face of Weld
Lamination at Angle to
Longitudinal Axis of Pipe Wall
Lamination Intersects Weld
D
t
t
Surface
Exposure
Surface
Exposure
Lamination
Lamination at Interior or
Exterior Surface
Legend
D – Outside Diameter of Pipe
t – Wall Thickness

Maximum Values of h for Pipe of Nominal Diameter 6.625				
	Nomimal Wall Thickness in Inches			
MOP	0.188	0.219	0.250	0.280
100	0.13	0.13	0.13	0.13
200	0.13	0.13	0.13	0.13
300	0.13	0.13	0.13	0.13
400	0.13	0.13	0.13	0.13
500	0.13	0.13	0.13	0.13
600	0.13	0.13	0.13	0.13
700	0.13	0.13	0.13	0.13
800	0.13	0.13	0.13	0.13
900	0.13	0.13	0.13	0.13
1000	0.13	0.13	0.13	0.13
1100	0.13	0.13	0.13	0.13
1200	0.12	0.13	0.13	0.13
1300	0.11	0.13	0.13	0.13
1400	0.10	0.12	0.13	0.13
1500	0.09	0.11	0.13	0.13
1600	0.08	0.10	0.12	0.13
1700	0.07	0.09	0.12	0.13
1800	0.06	0.08	0.11	0.12
1900	0.06	0.07	0.10	0.12
2000	0.06	0.07	0.09	0.11

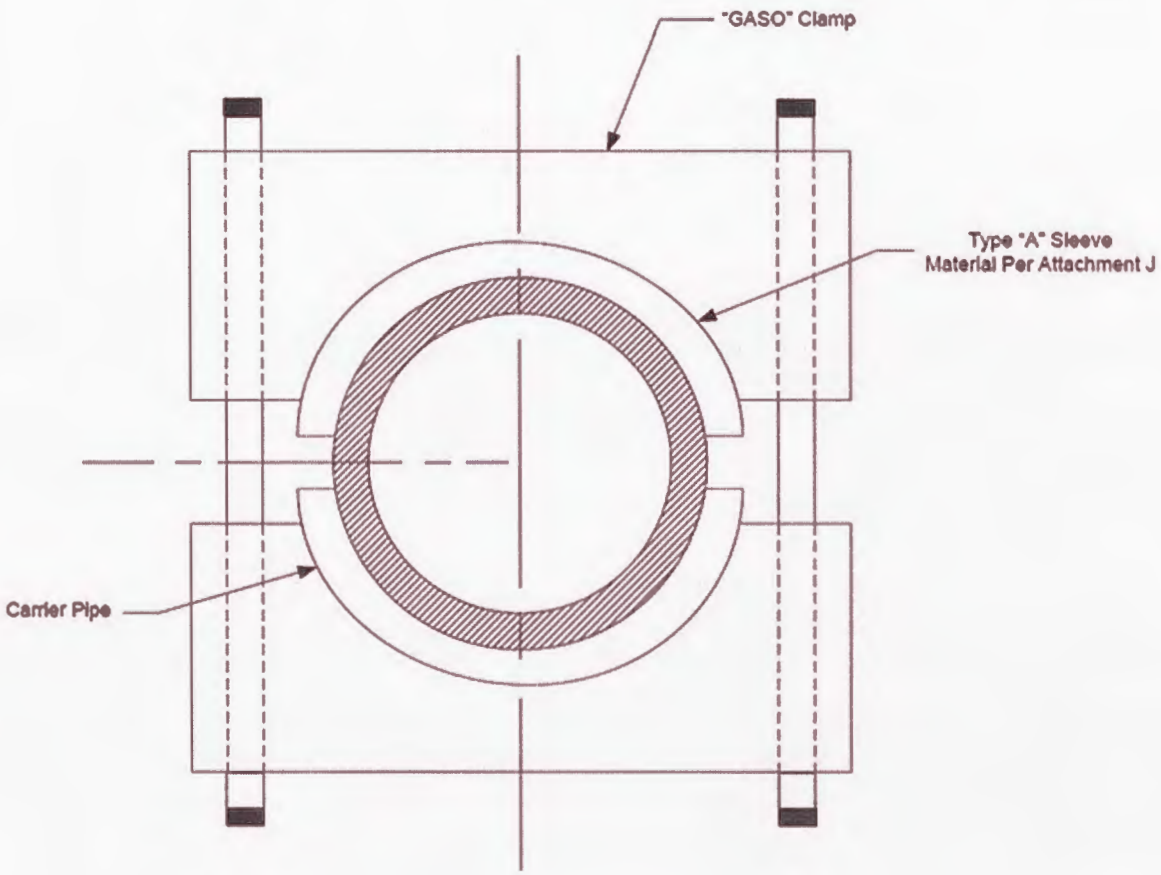
Maximum Values of h for Pipe of Nominal Diameter 6.625					
	Nomimal Wall Thickness in Inches				
MOP	0.203	0.219	0.277	0.322	0.500
100	0.17	0.17	0.17	0.17	0.17
200	0.17	0.17	0.17	0.17	0.17
300	0.17	0.17	0.17	0.17	0.17
400	0.17	0.17	0.17	0.17	0.17
500	0.17	0.17	0.17	0.17	0.17
600	0.17	0.17	0.17	0.17	0.17
700	0.17	0.17	0.17	0.17	0.17
800	0.17	0.17	0.17	0.17	0.17
900	0.17	0.17	0.17	0.17	0.17
1000	0.16	0.17	0.17	0.17	0.17
1100	0.14	0.16	0.17	0.17	0.17
1200	0.13	0.14	0.17	0.17	0.17
1300	0.11	0.12	0.17	0.17	0.17
1400	0.09	0.11	0.16	0.17	0.17
1500	0.08	0.09	0.14	0.17	0.17
1600	0.08	0.08	0.13	0.16	0.17
1700	0.07	0.08	0.12	0.15	0.17
1800	0.07	0.07	0.10	0.14	0.17
1900	0.06	0.07	0.09	0.13	0.17
2000	0.05	0.06	0.08	0.11	0.17

Maximum Values of h for Pipe of Nominal Diameter 10.75							
	Nominal Wall Thickness in Inches						
MOP	0.203	0.219	0.250	0.279	0.307	0.365	0.500
100	0.22	0.22	0.22	0.22	0.22	0.22	0.22
200	0.22	0.22	0.22	0.22	0.22	0.22	0.22
300	0.22	0.22	0.22	0.22	0.22	0.22	0.22
400	0.22	0.22	0.22	0.22	0.22	0.22	0.22
500	0.22	0.22	0.22	0.22	0.22	0.22	0.22
600	0.22	0.22	0.22	0.22	0.22	0.22	0.22
700	0.22	0.22	0.22	0.22	0.22	0.22	0.22
800	0.20	0.22	0.22	0.22	0.22	0.22	0.22
900	0.17	0.19	0.22	0.22	0.22	0.22	0.22
1000	0.15	0.17	0.20	0.22	0.22	0.22	0.22
1100	0.12	0.14	0.18	0.20	0.22	0.22	0.22
1200	0.10	0.11	0.15	0.18	0.20	0.22	0.22
1300	0.09	0.10	0.13	0.16	0.19	0.22	0.22
1400	0.09	0.09	0.11	0.14	0.17	0.21	0.22
1500	0.08	0.09	0.10	0.12	0.15	0.19	0.22
1600	0.07	0.08	0.09	0.10	0.13	0.18	0.22
1700	0.06	0.07	0.09	0.10	0.11	0.16	0.22
1800	0.05	0.06	0.08	0.09	0.10	0.15	0.22
1900	0.05	0.05	0.07	0.09	0.10	0.13	0.21
2000	0.05	0.05	0.07	0.08	0.09	0.11	0.20

Maximum Values of h for Pipe of Nominal Diameter 12.75								
	Nominal Wall Thickness in Inches							
MOP	0.219	0.250	0.281	0.312	0.344	0.375	0.406	0.500
100	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
200	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
300	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
400	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
500	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
600	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
700	0.25	0.26	0.26	0.26	0.26	0.26	0.26	0.26
800	0.21	0.25	0.26	0.26	0.26	0.26	0.26	0.26
900	0.18	0.22	0.25	0.26	0.26	0.26	0.26	0.26
1000	0.14	0.18	0.23	0.25	0.26	0.26	0.26	0.26
1100	0.12	0.15	0.19	0.22	0.25	0.26	0.26	0.26
1200	0.11	0.13	0.16	0.20	0.23	0.25	0.26	0.26
1300	0.10	0.12	0.13	0.17	0.20	0.23	0.25	0.26
1400	0.09	0.11	0.12	0.15	0.18	0.21	0.32	0.26
1500	0.08	0.10	0.11	0.13	0.16	0.18	0.21	0.26
1600	0.07	0.09	0.10	0.12	0.13	0.16	0.19	0.25
1700	0.06	0.08	0.10	0.11	0.12	0.14	0.17	0.23
1800	0.06	0.07	0.09	0.10	0.11	0.13	0.15	0.22
1900	0.06	0.06	0.08	0.09	0.11	0.12	0.13	0.20
2000	0.06	0.06	0.07	0.09	0.10	0.11	0.12	0.18

Use of Gaso Clamps

(Attachment S)



Spacing of clamps using 1 ½" B7 bolts.

Note: A minimum of three clamps should be used.

Nominal Pipe Size	Maximum Spacing
6" – 14"	16"
16"	14"
18"	12"
20"	11"
24"	9"

Maximum operating pressure: 1000 PSI

Note: Bolts shall be tightened with hammer wrench.