Attachment 1
Procedures for Repair of Steel Gas Pipelines

1. General

Repairs made to the Company's steel gas pipelines must be made according to the requirements in this standard. Criteria for selecting a repair method are listed, and repair methods are referenced to the appropriate gas standards listed throughout this document.

A. When a pipeline operating at > 20% of SMYS is discovered to be mechanically damaged, the pipeline pressure shall be reduced by 10% of the current operating pressure (or more, if more reduction is required to ensure a safe condition). Maintain this reduced pressure until the damage can be assessed or as required to ensure a safe condition. If it is discovered that a pipeline normally operating at < 20% of SMYS has been mechanically damaged, the pipeline pressure should not be increased above the operating pressure during the time of the incident, and the pressure shall be maintained or reduced until the damage can be assessed or as required to ensure a safe condition.

B. The Gas Control Center shall be notified of any mechanical damage on pipelines operating at greater than 60 psig. The Gas Control Center notifies the GSM&TS local pipeline engineer or the on-call engineer. Repairs are made only with the approval of the local GSM&TS engineer.

C. The operating pressure shall not be increased until it is determined that no repair is necessary or until repairs are completed.

D. This standard specifies that repairs be based on the MAOP and the percent of SMYS at its MAOP. Some repairs may limit the possibility of uprating a pipeline at pressures above the MAOP. Accordingly, use a repair method qualified for the future design pressure (FDP) when the FDP is greater than the MAOP (making future upgrades or uprating possible) and when removing the repaired section will not be practical or likely.

2. Defect Assessment Criteria

A. Acceptance criteria and allowed repair methods are provided for the following pipeline categories:

(1) For pipelines with MAOP > 60 psig but < 20% of SMYS, or MAOP ≥ 20% of SMYS reference the following tables, listed as Exhibits A through F of this attachment:

Table 1-A, "Acceptance Criteria and Allowed Repair Methods for Non-Leaking Corrosion Damage in Pipe and Welds"

Table 1-B, "Acceptance Criteria and Allowed Repair Methods for Leaking Corrosion Damage in Pipe and Welds"

Table 1-C, "Acceptance Criteria and Allowed Repair Methods for Dents Without Mechanical Damage (Plain Dents)"

Table, 1-D, "Acceptance Criteria and Allowed Repair Methods for Mechanical Damage (With or Without Dents)"

Table 1-E, "Acceptance Criteria and Allowed Repair Methods for Non-Leaking Cracks in Welds"

Table 1-F, "Acceptance Criteria and Allowed Repair Methods for Leaking Cracks in Welds"

(2) For pipelines with MAOP ≤ 60 psig, reference the following tables, listed as Exhibits G through L of this attachment:

Table 1-G, "Non-Leaking Corrosion Damage Repairing Steel Pipe Defects With MAOP ≤ 60 psig"

Table 1-H, "Leaking Corrosion Damage Reparing Steel Pipe Defects With MAOP ≤ 60 psig"

Table 1-I, "Non-Leaking Cracks or Defects in Welds Reparing Steel Pipe Defects With MAOP ≤ 60 psig"

Table 1-J, "Leaking Welds Reparing Steel Pipe Defects With MAOP ≤ 60 psig"

Table 1-K, "Leaks in body of Fittings or in Clamps Repairing Steel Pipe Defects With MAOP ≤ 60 psig"

Table 1-L, "Non-Leaking Mechanical Damage: Notches, Scratches, Gouges, Grooves, and Dents Repairing Steel Pipe Defects With MAOP ≤ 60 psig"

B. Repairs are required when the extent of the defect exceeds that allowed by the appropriate assessment criteria in the repair selection table. Work procedures and design requirements for allowable repair methods are provided in this standard or in the referenced gas standards.

C. Only those methods of repair recommended in this standard are approved as permanent repairs to welded steel mains. When a repair cannot be made in conformance with the conditions of this standard, the section of defective pipe shall be replaced with a good piece of pre-tested pipe.

D. For corrosion defects, a pipeline engineer, a corrosion engineer, or a senior distribution engineer can determine if the MAOP of the pipe needs to be reduced and the allowable extent

of defects. The engineer's determination shall be based on the American Society of Mechanical Engineers (ASME) B31G guidelines, RSTRENG, or other fitness-for-purpose methods approved by the GSM&TS Pipeline Engineering section.

E. 49 CFR Section 192.709 requires that each operator maintain information on the date, location, and description of each repair made to pipe and that information be kept for as long as the pipe remains in service. The "Leak Survey, Repair, Inspection, and Gas Quarterly Incident Report," (Form 62-4060 for distribution and Form F4110 for transmission), shall be used to collect this data. Instructions for filling out these forms are described in UO Standard D-S0350/S4110, "Leak Survey and Repair of Gas Transmission and Distribution Facilities."

F. Follow the procedures given in CGT Standard 4711, "Natural Gas Pipe Wrap: Removal, Handling, and Disposal," D-S0443, "Natural Gas Distribution Pipe Wrap Removal, Handling, and Disposal Procedure," and CGT Recommended Practice RP 4710, "Production Fluid/Pipeline Liquid – Leak Response and Contamination Soil Handling Procedure," when removing pipe wrap to repair.

G. The following information may need to be considered to support the defect assessment:
   (1) Class location.
   (2) MAOP.
   (3) Percentage of SMYS at MAOP.
   (4) Pipe grade.
   (5) Installation date.
   (6) Seam type and location. ERW seams may be located by etching or ultrasonic means. If an ERW seam has not been located on ERW pipe, the defect is assumed to be intruding into the ERW seam.
   (7) Any unusual soil movement or other sources of axial pipe stress that are known or suspected.
   (8) Determine if the defect is leaking.
   (9) Determine if the defect is corrosion-caused metal loss, either internal or external.
   (10) Determine if the defect is crack-like.
   (11) If the cause is third-party damage, determine if measurable denting is present. Also, determine if visible gouging or other mechanical damage is present in the dent or elsewhere.
   (12) Measure the depth of the defect. Depth measurements in welds should not include any portion of the weld cap that the defect may have removed. Detailed depth profiles of corrosion damage measured along the longitudinal axis of the pipe are required for RSTRENG analysis. Employees familiar with the requirements of the RSTRENG analysis shall perform such profile measurements.
   (13) For dents, the percentage of distortion is defined as the ratio of the depth of the dent to the actual diameter of the pipe, times 100.

3. Work Procedures and Design Requirements for Allowable Repair Methods

A. Type A sleeves shall be designed and installed in accordance with Gas Standard A-60.2.

B. Type B sleeves and fittings shall be designed and installed in accordance with Gas Standard A-60 or A-61.

C. Clock Spring repair shall be designed and installed by 1.) contractors qualified in the Clock Spring procedures or 2.) PG&E employees qualified by the Clock Spring company L.P.

D. Aquawrap shall be designed and installed by the vendor qualified by Air Logostics Corporation.

E. Repair patches shall be designed and installed in accordance with Gas Standard in A-64.

F. Direct deposition welding shall be performed in accordance with Gas Standard D-23.1

G. Mechanical clamps shall be designed and installed in accordance with Gas Standard B-53.2.

H. Grinding can be used to remove mechanical damage, if the associated dent does not exceed a depth of 4% of the outside diameter (OD) of the pipe. Grinding shall conform to the following procedure:

(1) Areas to be repaired shall be thoroughly cleaned before grinding.

(2) Grinding shall be performed to produce a smooth transition between the surface contour of the repaired area and the surrounding pipe surface. Grinding action shall be controlled to minimize the number of grinding marks oriented in the longitudinal direction.

(3) Grinding is permitted to a depth of 10% of the nominal material thickness with no limit on length. Grinding is permitted to a depth greater than 10% and up to a maximum of 40% of the nominal pipe-wall thickness, with the metal removal confined to a length given by the following equation:

$$L = 1.12\left\{(Dt)\left[\left(\frac{a/t}{1.1a/t - 0.11}\right)^2 - 1\right]\right\}^{1/2}$$

Where:
L = maximum allowable longitudinal extent of the ground area (inches)
D = nominal outside diameter of the pipe (inches)
a = measured maximum depth of the ground out area (inches)
t = nominal wall thickness of pipe (inches)

(4) The remaining wall thickness and geometry of the repaired area shall be verified ultrasonically and the information recorded on Form 62-4060 for distribution and Form F4110 for transmission.

(**Note:** Ultrasonic testing (UT) equipment is available to gas engineers and area foremen (AF). If grinding within the depth and length limitations fails to completely remove the damage, the damage shall be repaired using an alternate method, such as sleeving.

(5) The completed repair shall be polished using a 60-grit or finer sanding disk.

(6) If the completed repair exceeds a depth of 10% of the nominal material thickness, it shall be examined using magnetic particle examination, per requirements in Gas Standard D-40. Non-destructive evaluation (NDE) engineers in Technical and Ecological Services (TES) can provide this service.

I. Grinding and fill-welding shall be performed per Gas Standard D-22.

J. Individual gas pipe corrosion pits (either leaking, or non-leaking) may be repaired by using a 2-inch maximum fitting such as a Mueller Save-A-Valve nipple, Bonny Forge threadolet, or the equivalent, where the diameter of the defect at the surface of the pipe is less than the inside diameter of the fitting used for repair. The weld shall be visually inspected. Follow Gas Standard A-53 or B-23 for installation procedures.

K. Canning: Gas main repair cans may be used for repairs on pipelines with a design pressure that produces a hoop stress of less than 20% SMYS, and not exceeding 400 psig. Cans shall be designed and tested according to Gas Design Standard A-63.

L. Pipe replacement shall use emergency, pre-tested pipe, per CGT Engineering Guideline EG 4124, or the pipe shall be field tested as described in Gas Standard A-34.

M. When practical, corrosion in girth welds that extends below the pipe body surface should be repaired using direct deposition welding, fill welding, or other approved methods. When repair is not practical, such corrosion may be evaluated using the procedure documented in Pipeline Research Council International, Inc. (PRCI) Report L51742, "Serviceability of Corroded Girth Welds." However, if it fails the evaluation, the corrosion must be repaired.

The L51742 procedure has three steps, which must be addressed for the corrosion to be acceptable:

(1) The corroded area must successfully pass ASME B31G or RSTRENG analysis.

(2) The corroded area must be inspected using magnetic particle and ultrasonic examination to verify the weld contains no other flaws. If other flaws are present, L51742 provides evaluation criteria.

(3) Calculation of longitudinal stresses and allowable longitudinal stresses is performed. The pipeline engineer, using the formulas provided in L51742, should perform these calculations.

N. **Corrosion on DSAW seams** can be evaluated and repaired following the same rules as those applicable to the corrosion on pipe base metal.

O. **Corrosion on wrinkle bends** – Corrosion on large diameter pipe (over 30" OD) wrinkle bends can be evaluated **using RSTRENG and shall be repaired if the calculated Psafe is not greater than the MAOP by more than 5%.** (This is based on the L-300A wrinkle bends hydrostatic testing and the finite element analysis results by Structure Integrity Inc.)

Cathodic Protection Requirements for Leak Repairs

If a transmission leak is corrosion-related, contact either the CGT corrosion engineer or senior corrosion specialist for cathodic protection requirements. See also UO Standard S4133 and Gas Standard O-16.

Exhibit A **Table 1-A - Acceptance Criteria and Allowed Repair Methods for Non-Leaking Corrosion Damage in Pipe and Welds**

Acceptance Criteria or Permitted Repair Technique	Limitations on Use for Described Service Conditions	
	MAOP > 60 psig and < 20% of SMYS	MAOP ≥ 20% of SMYS
No repair required.	A. Maximum depth of corrosion ≤ 20% of nominal pipe wall thickness. **Or** B. Maximum depth of corrosion ≤ 80% of nominal pipe wall thickness and RSTRENG analysis finds corrosion to be acceptable.	A. Maximum depth of corrosion ≤ 20% of nominal pipe wall thickness, **and** pipe is not known or suspected to experience unusual axial loading, **and** corrosion does not intrude into a weld. **Or** B. Maximum depth of corrosion ≤ 80% of nominal pipe wall thickness, **and** RSTRENG analysis finds corrosion to be acceptable, **and** pipe is not known or suspected to experience unusual axial loading, **and** corrosion does not intrude into a weld. **Or** C. Corrosion in welds that does not extend below the pipe body surface. Deeper corrosion in girth welds may be acceptable if analysis per Paragraph 3.K is successful.
Type A sleeve (install per A-60.2).	Maximum depth of corrosion < 80% of nominal pipe thickness, **and** RSTRENG analysis finds corrosion to be unacceptable, **and** unusual axial or bending loading is not suspected.	Maximum depth of corrosion < 80% of nominal pipe thickness, **and** RSTRENG analysis finds corrosion to be unacceptable, **and** the area to be sleeved does not include a potentially non-ductile weld, **and** unusual axial or bending loading is not suspected.
Clock Spring (Install per manufacturer's instructions)	Maximum depth of corrosion < 80% of nominal pipe thickness, **and** RSTRENG analysis finds corrosion to be unacceptable, **and** unusual axial or bending loading is not suspected.	Maximum depth of corrosion < 80% of nominal pipe thickness, **and** RSTRENG analysis finds corrosion to be unacceptable, **and** the area to be repaired does not include a potentially non-ductile weld, **and** unusual axial or bending loading is not suspected.
Aquawrap (Install per manufacturer's instructions)	Maximum depth of corrosion < 80% of nominal pipe thickness, **and** RSTRENG analysis finds corrosion to be unacceptable, **and** unusual axial or bending loading is not suspected.	Maximum depth of corrosion < 80% of nominal pipe thickness, **and** RSTRENG analysis finds corrosion to be unacceptable, **and** the area to be repaired does not include a potentially non-ductile weld, **and** unusual axial or bending loading is not suspected.

Table 1-A (continued) - Acceptance Criteria and Allowed Repair Methods for Non-Leaking Corrosion Damage in Pipe and Welds

Acceptance Criteria or Permitted Repair Technique	Limitations on Use for Described Service Conditions	
	MAOP > 60 psig and < 20% of SMYS	MAOP ≥ 20% of SMYS
Type B sleeve (install per A-60 or A-60.1).	When RSTRENG analysis finds corrosion to be unacceptable.	When RSTRENG analysis finds corrosion to be unacceptable. If the corroded area includes a potentially non-ductile weld, the sleeve shall be pressurized by tapping through the carrier pipe.
Patches (install per A-64).	When RSTRENG analysis finds corrosion to be unacceptable, **and** the area to be patched may not include a circumferential weld, **and** SMYS of pipe ≤ 40 ksi, **and** circumferential and longitudinal dimensions of patch each may not exceed ½ of pipe circumference.	When RSTRENG analysis finds corrosion to be unacceptable, **and** the area to be patched may not include a circumferential weld **or** a potentially non-ductile seam weld, **and** SMYS of pipe ≤ 40 ksi, **and** circumferential and longitudinal dimensions of patch each may not exceed ½ of pipe circumference.
Direct deposition welding – no pressure reduction for welding (perform per D-23.1).	When RSTRENG analysis finds corrosion to be unacceptable, **and** the remaining wall in corroded area ≥ 0.156 inches.	When RSTRENG analysis finds corrosion to be unacceptable, **and** the area to be repaired shall not include a potentially non-ductile weld, **and** remaining wall in corroded area ≥ 0.156 inches.
Repair of pits by fill-welding – requires blow down (perform per D-22).	When RSTRENG analysis finds corrosion to be unacceptable. After welding, the location must be acceptable when evaluated as "non-leaking corrosion damage."	When RSTRENG analysis finds corrosion to be unacceptable. After welding, the location must be acceptable when evaluated, as "non-leaking corrosion damage," **and** the area to be repaired shall not include a potentially non-ductile weld.
Mueller Save-A-Valve nipple or Bonny Forge threadolet (install per A-53 or B-23).	When RSTRENG analysis finds corrosion to be unacceptable. A 2-inch maximum fitting may be used for repairing external corrosion, **and** it must be welded to non-corroded material.	When RSTRENG analysis finds corrosion to be unacceptable. A 2-inch maximum fitting may be used for repairing external corrosion, **and** it must be welded to non-corroded material, **and** the repair shall not include a potentially non-ductile weld.
Pipe replacement.	May be used without restriction.	May be used without restriction.

Exhibit B **Table 1-B - Acceptance Criteria and Allowed Repair Methods for Leaking Corrosion Damage in Pipe and Welds**

Acceptance Criteria or Permitted Repair Technique	Limitations on Use for Described Service Conditions	
	MAOP > 60 psig and < 20% of SMYS	MAOP ≥ 20% of SMYS
Type B sleeve – requires blow down (install per A-60 or A-60.1).	May be used without restriction.	May be used without restriction.
Patches – requires blow down (install per A-64).	The area to be patched may not include a circumferential weld, **and** SMYS of pipe ≤ 40 ksi, **and** the circumferential and longitudinal dimensions of the patch each may not exceed ½ of the pipe circumference.	The area to be patched may not include a circumferential weld **or** a potentially non-ductile seam weld, **and** SMYS of pipe ≤ 40 ksi, **and** the circumferential and longitudinal dimensions of the patch each may not exceed ½ of the pipe circumference.
Repair leaking pits by fill-welding – requires blow down (perform per D-22).	After welding, the location must be acceptable when evaluated as "non-leaking corrosion damage."	The area to be repaired shall not include a potentially non-ductile weld. After welding, the location must be acceptable when evaluated as "non-leaking corrosion damage."
Mueller Save-A-Valve nipple or Bonny Forge threadolet (install per A-53 or B-23).	A 2-inch maximum fitting may be used for repairing external corrosion on pipe only, **and** it must be welded to non-corroded material.	A 2-inch maximum fitting **may** be used for repairing external corrosion on pipe only, **and** it must be welded to non-corroded material. The repair shall not include a potentially non-ductile weld.
Mechanical clamp (install per B-53.2).	May be used without welding for a pinhole corrosion leak only and shall be welded under other conditions.	May be used without welding for a pinhole corrosion leak only and shall be welded under other conditions. The area to be repaired shall not include a potentially non-ductile seam weld. **Note:** Consider welding the clamp, depending on class location, line pressure over 500 psig, pipe diameter, and remaining service life.
Pipe replacement.	May be used without restriction.	May be used without restriction.

Exhibit C **Table 1-C - Acceptance Criteria and Allowed Repair Methods for Dents Without Mechanical Damage (Plain Dents)**

Acceptance Criteria or Permitted Repair Technique	Limitations on Use for Described Service Conditions	
	MAOP > 60 psig and < 20% of SMYS	MAOP ≥ 20% of SMYS
No repair required.	A. Plain dents with a depth of ≤ 2% of the nominal pipe diameter. **Or** B. Plain dents with a depth of ≤ 6% of the nominal pipe diameter, provided that the dent does not infringe on a weld. **Or** C. Plain dents with a maximum strain ≤ 2% as calculated using the rules in Attachment 2. **Or** D. Plain dents with a maximum strain ≤ 6% as calculated using the rules in Attachment 2, provided that the dent does not infringe on a weld.	A. Plain dents with a depth of ≤ 2% of the nominal pipe diameter provided dent does not infringe on a potentially non-ductile weld. **Or** B. Plain dents with a depth of ≤ 6% of the nominal pipe diameter, provided that the dent does not infringe on a weld. **Or** C. Plain dents with a maximum strain ≤ 2% as calculated using the rules in Attachment 2, provided that the dent does not infringe on a potentially non-ductile weld. **Or** D. Plain dents with a maximum strain ≤ 6% as calculated using the rules in Attachment 2, provided the dent does not infringe on a weld.
Type A sleeve (install per A-60.2).	Maximum dent depth ≤ 10% of the nominal pipe diameter, **and** area to be sleeved shall not include a circumferential weld, **and** unusual axial or bending loading is not suspected.	Maximum dent depth ≤ 10% of the nominal pipe diameter, **and** the area to be sleeved does not include a circumferential weld. The dent must not intrude into a potentially non-ductile weld, **and** unusual axial or bending loading is not suspected.
Clock Spring (Install per manufacturer's instructions)	Maximum dent depth ≤ 10% of nominal pipe diameter, **and** area to be sleeved does not include a circumferential weld **and** unusual axial or bending loading is not suspected.	Maximum dent depth ≤ 10% of nominal pipe diameter, **and** area to be sleeved does not include a circumferential weld, **and** the area to be repaired does not intrude into a potentially non-ductile weld, **and** unusual axial or bending loading is not suspected.

Table 1-C (continued) - Acceptance Criteria and Allowed Repair Methods for Dents Without Mechanical Damage (Plain Dents)

Acceptance Criteria or Permitted Repair Technique	Limitations on Use for Described Service Conditions	
	MAOP > 60 psig and < 20% of SMYS	**MAOP ≥ 20% of SMYS**
Type B sleeve (install per A-60 or A-60.1).	Maximum dent depth ≤ 10% of the nominal pipe. May be used without restriction.	Maximum dent depth ≤ 10% of the nominal pipe. If the dented area includes a potentially non-ductile weld, the sleeve shall be pressurized by tapping through the carrier pipe.
Canning (install per A-63).	Maximum dent depth ≤ 10% of the nominal pipe. MAOP shall not exceed 400 psig.	Not permitted.
Mueller Save-A-Valve nipple or Bonny Forge threadolet (install per A-53 or B-23).	A 2-inch maximum fitting size, **and** the dent must be completely contained by fitting.	A 2-inch maximum fitting size, **and** the dent must be completely contained by nipple. The repair shall not include a potentially non-ductile weld.
Pipe replacement.	May be used without restriction.	May be used without restriction.

Exhibit D Table 1-D - Acceptance Criteria and Allowed Repair Methods for Mechanical Damage (With or Without Dents)

Acceptance Criteria or Permitted Repair Technique	Limitations on Use for Described Service Conditions	
	MAOP > 60 psig and < 20% of SMYS	MAOP ≥ 20% of SMYS
No Repair Required	Minor tooling marks, rolling scabs, or other minor imperfections from original fabrication and installation do not require repair unless they exceed 10% of nominal wall thickness, **or** are present in conjunction with dent depth > 4% of nominal pipe diameter.	Minor tooling marks, rolling scabs, or other minor imperfections from original fabrication and installation do not require repair unless they exceed 10% of nominal wall thickness, **or** are present in conjunction with dent depth > 4% of nominal pipe diameter.
Grinding (see Paragraph 3.H).	Dent depth shall be ≤ 4% of nominal pipe diameter, **and** damage shall not intrude into the weld. The finished cavity depth shall not exceed 40% of the nominal pipe wall thickness, **and** longitudinal length shall not exceed the value calculated using the formula in Paragraph 3.H.	Dent depth shall be ≤ 4% of nominal pipe diameter, **and** damage shall not intrude into the weld. The finished cavity depth shall not exceed 40% of nominal pipe wall thickness, **and** longitudinal length shall not exceed the value calculated using the formula in Paragraph 3.H.
Type A sleeve (install per A-60.2).	Maximum depth of mechanical damage after grinding ≤ 80% of nominal pipe thickness, **and** maximum dent depth ≤ 10% of the nominal pipe or fitting diameter. The area to be sleeved shall not include a circumferential weld, **and** unusual axial or bending loading is not suspected.	Maximum depth of mechanical damage after grinding ≤ 80% of nominal pipe thickness, **and** maximum dent depth ≤ 10% of the nominal pipe or fitting diameter. The damage does not intrude into a potentially non-ductile weld, **and** the area to be sleeved shall not include a circumferential weld, **and** unusual axial or bending loading is not suspected.
Clock Spring (Install per manufacturer's instructions)	Maximum depth of mechanical damage after grinding ≤ 80% of nominal pipe thickness, **and** maximum dent depth ≤ 10% of nominal pipe or fitting diameter. The area to be sleeved shall not include a circumferential weld, **and** unusual axial or bending loading is not suspected.	Maximum depth of mechanical damage after grinding < 80% of nominal pipe thickness, **and** maximum dent depth ≤ 10% of nominal pipe or fitting diameter. The damage does not intrude into a potentially non-ductile weld, **and** the area to be repaired shall not include a circumferential weld, **and** unusual axial or bending loading is not suspected.
Aquawrap (Install per manufacturer's instructions)	Maximum depth of mechanical damage after grinding < 80% of nominal pipe thickness, **and no dent**. The area to be sleeved shall not include a circumferential weld, **and** unusual axial or bending loading is not suspected.	Maximum depth of mechanical damage after grinding < 80% of nominal pipe thickness, **and no dent.** The damage does not intrude into a potentially non-ductile weld, **and** the area to be repaired shall not include a circumferential weld, **and** unusual axial or bending loading is not suspected.

Table 1-D (Continued) – Acceptance Criteria and Allowed Repair Methods for Mechanical Damage (With or Without Dents)

Acceptance Criteria or Permitted Repair Technique	Limitations on Use for Described Service Conditions	
	MAOP > 60 psig and < 20% of SMYS	MAOP ≥ 20% of SMYS
Type B sleeve (install per A-60 or A-60.1).	Maximum dent depth ≤ 10% of the nominal pipe.	Maximum dent depth ≤ 10% of the nominal pipe. If the area to be sleeved includes a potentially non-ductile weld, the sleeve shall be pressurized by tapping through the carrier pipe.
Canning (install per A-63).	Maximum dent depth ≤ 10% of the nominal pipe, **and** MAOP shall not exceed 400 psig.	Not permitted.
Mueller Save-A-Valve nipple or Bonny Forge threadolet (install per A-53 or B-23).	Repair on pipe only, 2-inch maximum fitting size, **and** damage must be completely contained by the fitting.	Repair on pipe only, 2-inch maximum fitting size, **and** damage must be completely contained by the fitting.
Pipe replacement.	May be used without restriction.	May be used without restriction.

Exhibit E **Table 1-E - Acceptance Criteria and Allowed Repair Methods for Non-Leaking Cracks in Welds**

Acceptance Criteria or Permitted Repair Technique	Limitations on Use for Described Service Conditions	
	MAOP > 60 psig and < 20% of SMYS	MAOP ≥ 20% of SMYS
Grinding and fill-welding – requires reducing pressure for welding (perform per D-22).	Not applicable for repairing cracks in original pipe longitudinal seam welds. Cracks in circumferential or branch-connection welds may be repaired with this method, provided that the crack is 8% or less of the weld length, **and** a minimum of ⅛ -inch thickness of weld must remain under the area after grinding.	Not applicable for repairing cracks in original pipe longitudinal seam welds. Cracks in circumferential or branch-connection welds may be repaired with this method, provided that the crack is 8% or less of the weld length, **and** a minimum of ⅛ -inch thickness of weld must remain under the area after grinding.
Grinding and fill-welding – requires blow down (perform per D-22).	Not applicable for repairing cracks in the original pipe longitudinal seam welds. Cracks in circumferential or branch-connection welds may be repaired with this method, provided that the crack is 8% or less of the weld length.	Not applicable for repairing cracks in the original pipe longitudinal seam welds. Cracks in circumferential or branch-connection welds may be repaired with this method, provided that the crack is 8% or less of the weld length.
Type B sleeve (install per A-60 or A-60.1).	May be used without restriction.	If the area to be sleeved includes a potentially non-ductile weld, the sleeve shall be pressurized by tapping through the carrier pipe.
Pipe replacement.	May be used without restriction.	May be used without restriction.

Exhibit F **Table 1-F - Acceptance Criteria and Allowed Repair Methods for Leaking Cracks in Welds**

Acceptance Criteria or Permitted Repair Technique	Limitations on Use for Described Service Conditions	
	MAOP > 60 psig and < 20% of SMYS	MAOP ≥ 20% of SMYS
Type B sleeve – requires blow down (install per A-60 or A-60.1).	May be used without restriction.	May be used without restriction.
Grinding and fill-welding – requires blow down (perform per D-22).	Not applicable for repairing cracks in original longitudinal seam welds. A circumferential or branch-connection weld with a crack that is 8% or less of the weld length may be repaired with this method.	Not applicable for repairing cracks in original longitudinal seam welds. A circumferential or branch-connection weld with a crack that is 8% or less of the weld length may be repaired with this method.
Mechanical clamp – temporary repair only, unless welded out (install per B-53.2).	May be used without restriction.	The area to be repaired shall not include a potentially non-ductile seam weld.
Pipe replacement.	May be used without restriction.	May be used without restriction.

Exhibit G **Table 1-G - Non-Leaking Corrosion Damage Repairing Steel Pipe Defects With MAOP ≤ 60 psig**

Extent of Defect	Permissible Methods of Repair	Limitations on Methods
Depth ≤ 50% of the pipe wall thickness.	No repair required.	None.
Depth > 50% of the pipe-wall thickness, but < 80%.	Grinding and welding.	A repair is not to exceed ¼ of the circumference of the pipe or 5 inches square. There shall not be more than one repair per foot of pipe length.
	Patching.	A patch is not to exceed ½ of the pipe circumference. On pipe over 8⅝ inches OD, the length is not to exceed 10 pipe diameters. There shall be a 3-inch minimum clearance between patches.
	Sleeving or canning.	No limitations.
	Mueller Save-A-Valve nipple.	2-inch maximum size.
	Leak clamps.	See Gas Standards B-53 and B-53.1.
	Leak repair tapes.	Limited to low pressure (LP) (14-inch WC) applications where other repairs are not feasible and subject to the conditions in Gas Standard A-68.
Depth ≥ 80% of the pipe wall thickness.	Patching.	A patch is not to exceed ½ of the pipe circumference. On pipe over 8⅝ inches OD, the length is not to exceed 10 pipe diameters. There shall be 3-inch minimum clearance between patches.
	Sleeving or canning.	No limitations.
	Mueller Save-A-Valve nipple.	2-inch maximum size.
	Leak clamps.	See Gas Standards B-53 and B-53.1.
	Leak repair tapes.	Limited to LP (14-inch WC) applications, where other repairs are not feasible and are subject to the conditions in Gas Standard A-68.
	Replace segment of pipe.	If the above limitations are exceeded for this "extent of defect," the entire affected section must be removed.

Exhibit H **Table 1-H - Leaking Corrosion Damage**
Repairing Steel Pipe Defects With MAOP ≤ 60 psig

Extent of Defect	Permissible Methods of Repair	Limitations on Methods
Leaking corrosion pits.	Patching.	A patch is not to exceed ½ of the pipe circumference. On pipe over 8⅝ inches OD, the length is not to exceed 10 pipe diameters. There shall be 3-inch minimum clearance between patches.
	Sleeving or canning.	No limitations.
	Mueller Save-A-Valve nipple.	2-inch maximum size.
	Leak clamps.	See Gas Standards B-53 and B-53.1.
	Leak repair tapes.	Limited to LP (14-inch WC) applications, where other repairs are not feasible and subject to the conditions in Gas Standard A-68.
	Replace a segment of pipe.	If the above limitations are exceeded for this "extent of defect," the entire affected section must be removed.

Exhibit I **Table 1-I - Non-Leaking Cracks or Defects in Welds Repairing Steel Pipe Defects With MAOP ≤ 60 psig**

Extent of Defect	Permissible Methods of Repair	Limitations on Methods
Any longitudinal weld crack ≤ 2 inches long, a branch or circumferential weld-crack ≤ 8% of the weld length (approximately 1 inch per 12 inches), or other defects.	Grinding or fill-welding.	If the crack penetrates either the root or the second bead, replace the pipe segment.
	Patching, sleeving, or canning.	Limitations for patches: A patch is not to exceed ½ of the pipe circumference. On a pipe over 8⅝ inches OD, the length is not to exceed 10 pipe diameters. A minimum of 3-inch clearance between patches is required.
	Replace the segment of pipe or, if it is not feasible to take the pipe out of service, install a sleeve.	If the above limitations are exceeded for this "extent of defect," the entire affected section must be removed. If it is not feasible to take the pipe out of service, install a sleeve.
Any longitudinal weld crack > 2 inches long, a branch or circumferential weld crack ≥ 8% of weld length (approximately 1 inch per 12 inches), or a crack that penetrates either the root or second bead.	Replace the segment of pipe or, if it is not feasible to take the pipe out of service, install a sleeve.	The entire affected section must be removed. If it is not feasible to take the pipe out of service, install a sleeve.

Exhibit J **Table 1-J - Leaking Welds**
Repairing Steel Pipe Defects With MAOP ≤ 60 psig

Extent of Defect	Permissible Methods of Repair	Limitations on Methods
All.	Patching.	Existing facilities only. The patch is not to exceed ½ of the pipe circumference. On pipe over 8⅝ inches OD, the length is not to exceed 10 pipe diameters. There shall be a 3-inch minimum clearance between patches.
	Sleeving or canning.	Existing facilities only.
	Mueller Save-A-Valve nipple.	2-inch maximum size. Existing facilities only.
	Leak clamps.	See Gas Standards B-53 and B-53.1.
	Leak repair tapes.	Limited to LP (14-inch WC) applications where other repairs are not feasible and are subject to the conditions in Gas Standard A-68.

Exhibit K **Table 1-K - Leaks in Body of Fittings or in Clamps**
Repairing Steel Pipe Defects With MAOP ≤ 60 psig

Extent of Defect	Permissible Methods of Repair	Limitations on Methods
All.	Canning.	Existing facilities only.
	Replace fitting or clamp.	No limitations.

Exhibit L Table 1-L – Non-Leaking Mechanical Damage: Notches, Scratches, Gouges, Grooves, and Dents Repairing Steel Pipe Defects With MAOP ≤ 60 psig

Extent of Defect	Permissible Methods of Repair	Limitations on Methods
Dent ≤ 10% distortion (½ foot for 4½-inch OD and smaller pipe).	No repair required.	No notches, scratches, gouges, or grooves in the dent.
Dent > 10% distortion (½ foot for 4½-inch OD or smaller pipe).	Sleeving or canning.	The dent must not prevent proper fit up.
	The entire affected section must be removed.	If the above limitations are exceeded for this "extent of defect," the entire affected section must be removed.
A notch, scratch, gouge, or groove ≤ 50% of the pipe-wall thickness.	Grinding.	Less than 10% distortion or dent (½ inch for 4½-inch OD and smaller pipe). The pipe wall is not to be reduced to less than 50% of the original nominal wall-thickness.
A notch, scratch, gouge, or groove > 50% of the pipe-wall thickness.	Grinding and welding.	Less than 10% distortion or dent (½ inch for 4½-inch OD and smaller pipe). The repair is not to exceed ¼ of the pipe circumference or 5 inches square. There shall not be more than one repair per foot of pipe length.
	Patching.	Less than 10% distortion or dent (½ inch for 4½ inch OD and smaller pipe). The patch is not to exceed ½ of the pipe circumference. On pipe over 8⅝ inches OD, the length is not to exceed 10 pipe diameters. There shall be a 3-inch minimum clearance between patches.
	Sleeving or canning.	The dent must not prevent proper fit up.
	Replace segment of pipe.	If the above limitations are exceeded for this "extent of defect," the entire affected section shall be removed.