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1 PURPOSE AND SCOPE

1.1 This specification governs piping design, materials selection, components, shop and field fabrication, testing, and certification at Westlake Geismar.

2 GENERAL

2.1 Referenced Specifications and Standards

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ASME B16.11	Forged fittings- socket welding and threaded
ASME B16.20	Metallic gaskets for pipe flanges
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GES-601	Painting and Protective Coatings
GSM-MP-GEN-005	Torqueing
MSS SP-95	Swage Nipples and Bull Plugs

2.2 Specifications, standards, and codes referred to herein shall be of the latest issue including all addenda, interpretations, revisions, or supplements thereto. In addition to the standard specifications listed, all work shall conform to applicable national, state and local codes.

2.3 All conflicts between requirements of this specification, related codes, regulatory bodies, standards, drawings, or purchase documents shall be listed and referred to Westlake Mechanical Integrity for clarification before proceeding with any work concerned with the conflict.

2.4 Should any additional specifications be required, or any corrections be needed, Westlake Mechanical Integrity will make the additions or changes.

2.5 All piping design and fabrication shall be in accordance with ASME B31.3.

2.6 The following standard abbreviations are used within Westlake Geismar piping specifications.

Abbreviations	Definitions
3,000#	Equivalent Pressure Class
B&S	Bell and Spigot
BE	Beveled End
BW	Butt Weld
CI	Cast Iron
CL	Class
CS	Cast Steel
DI	Ductile Iron
EFW	Electric Fusion Weld
EQ	Equal
ERW	Electric Resistance Weld
FCAW	Flux Core Arc Weld
FF	Flat Face
FFU	Field Fit Up
FLGD	Flanged
FS	Forged Steel
GMAW	Gas Metal Arc Weld (spray transfer mode only)
GR	Grade
GTAW	Gast Tungsten Arc Weld (non-consumable electrode)
HSE	Health, Safety, and Environmental
HVY	Heavy

ITP	Inspection and Test Plan
LGR	Larger
LR	Long Radius
NDE	Non-destructive Evaluation
PE	Plain End
PERF	Perforations
PQR	Procedure Qualification Record
PT	Dye Penetrant Testing
PWHT	Post-weld Heat Treatment
RF	Raised Face
RJ	Ring Joint
RT	Radiography Testing
RTJ	Ring Type Joint
S/40	Equivalent Schedule Number
SAW	Submerged Arc Weld (fully automatic)
SMAW	Shielded Metal Arc-covered Weld (covered electrode)
SMLR	Smaller
SMLS	Seamless
SO	Slip-On
SR	Short Radius
SS	Stainless Steel
STD WT	Standard Weight
SW	Socket Weld
T&G	Tongue and Groove
THK	Thick
THRD	Threaded
WN	Weld Neck
WPS	Welding Procedure Specification
WT	Wall Thickness

2.7 Changes to piping specifications that result in changes of materials of construction, updates to P&IDs, or any other change requiring management of change (MOC) per Process Safety Management Procedure “PSM10 – Management of Change (MOC)” must be conducted through the MOC process and then through Westlake Geismar’s electronic document control and management software. All other changes can be managed and approved only through Westlake Geismar’s electronic document management software.

3 DESIGN

3.1 The pipe specification selected for a specific service shall be governed by the maximum operating conditions of pressure, temperature, corrosion allowance, and compatibility with contained media.

3.1.1 The maximum pressure will be the relief valve setting; centrifugal pump shut-off head; or stalling head developed by a reciprocating pump or compressor (if no relief valve).

3.1.2 The temperature shall be the maximum line temperature, plus 25°F, except for special cases.

3.1.3 In accordance with ASME B31.3; where infrequent variations of short duration in the pressure or temperature, or both from normal operation are characteristic of a service, the pressure-temperature rating of the piping components may be adjusted as follows:

3.1.3.1 When the increased operating condition will not exceed 10 hours at any one time or 100 hours per year, it is permissible to increase the pressure rating at the temperature existing during the increased operating condition by a maximum of 33%.

3.1.3.2 When the increased operating condition will not exceed 50 hours at any one time or 500 hours per year, it is permissible to increase the pressure rating at the temperature existing during the increased operating condition by a maximum of 20%.

3.1.3.3 When two lines that operate at different pressure-temperature conditions are connected, the valve and/or gaskets segregating the two lines shall be rated for the more severe service condition.

3.1.3.4 When a line is connected to a piece of equipment, which operates at a higher pressure-temperature condition than that of the line, the valve and/or gaskets segregating the line from the equipment shall be rated for at least the operating condition of the equipment.

3.2 Pipe wall thickness shall be calculated in accordance with the applicable section of ASME B31.3.

3.3 Piping component wall thickness is based on pressure design thickness, considering a corrosion allowance and manufacturing tolerance.

3.3.1 The minimum corrosion allowance for carbon and ferritic steel shall be 0.05 inches, and for austenitic or stainless steel alloys the allowance shall be 0.03 inches.

3.3.2 The wall thickness calculated shall be increased by an amount sufficient to provide the manufacturing tolerance allowed in the applicable pipe specification.

3.4 All components of a pipe line shall be selected from the applicable Piping Specifications. Sizes 3/8", 1-¼", 2-½". 3-½", 4-½", and 5" shall not be used, except where required to make connections to vendor-equipment or for pneumatic conveying systems. Unless otherwise indicated, piping components are specified to be adequate for the full flange rating of pressure class.

4 DRAWINGS

4.1 All piping appearing on P&IDs shall be identified, and line indexes shall be prepared.

4.2 The following method of line designation will be used on flow diagrams and piping drawings.

1”-S180-123456-A-1.5”-H

where

1”	=	line size
S180	=	service code
123456	=	line number
A	=	piping specification
1.5”	=	insulation thickness
H	=	hot (H) or cold (C) insulation

4.3 The piping drafter shall prepare piping plans and isometrics that describe pipe size, piping specification, piping elevation and routing of the piping. Piping details shall be prepared to clarify plan drawings only when necessary. Details must be shown on the design drawings for any special designs such as pipe bends and reinforcing pads.

4.4 Piping design shall conform to requirements of the P&ID's.

4.5 The piping drafter shall coordinate the piping drawings with other disciplines to avoid interferences.

4.6 The piping drafter shall take required field dimensions and prepare his drawings to be correct within 1/8" accuracy. In the event this accuracy cannot be obtained, the piping drawings shall indicate location of the required field fit up (FFU). (The Contractor's pipe spooler is responsible for designating field welds required for shipping and erection.)

4.7 Piping drawings shall use the project's bench mark for elevation and lateral dimensions basis.

4.8 The piping isometrics shall be prepared on 11" x 17" sheets and show each line complete with all items required for final assembly, plus a bill of material of all piping items. Instrument items are not shown on bill of material except for orifice flanges. In-line instrument numbers are shown on the plan and isometric drawings.

4.9 Dimensions on drawings are in feet and inches. Dimensions less than 1' 0" are shown as in the example: 0'- 1''

4.10 Dimensions are centerline of pipe to centerline of pipe, centerline of pipe to face of component flange, centerline of pipe to face of opposing flange, face-to-face of component flanges and face-to-face of opposing flanges. Where dimensions are shown to contact face of opposing flanges, the gaskets, slip blinds, rings, etc., are included in the overall dimensions. Dimensions for ring joint flanges are to the face of flange and not to the contact surface of the groove.

4.11 Flanges and fittings which differ from the line material specifications are so noted on the drawings.

4.12 The amount of cold spring (designated "CS") indicated on the spool drawings is determined by equipment loading or flexibility requirements as defined by design studies. In all cases, the spring as required shall be deducted from or added to the dimensions shown on the drawings. Refer to ASME B31.3.

4.13 In general, all pipelines shall be guided as shown on the piping drawings. Place guides 40 to 60 pipe diameters from expansion loops or changes in direction. In general guide lines 4" and smaller at

every other support. Guide lines 6" and larger at every third support. Stagger the guides on adjacent lines. The guides must be positioned to restrict lateral movement of straight runs without impairing the flexure of bends or loops. Pipe anchors shall be shown on the drawings. Requirements for anchors shall be determined by the piping engineer. The piping engineer must consider hydraulic forces due to normal operation and minimize excessive movement.

4.14 Unless otherwise noted on the piping drawings, flange bolt holes shall straddle the vertical and horizontal centerlines and shall match the orientation of mating flanges (commonly referred to as the “two hole” configuration).

4.15 Existing piping and equipment are represented by dashed lines. New piping is represented by solid lines.

5 CONSTRUCTION

5.1 Materials

5.1.1 Deviation from any of the aforementioned requirements shall be cause for rejection of the material along with any attachments thereto.

5.1.2 Substitutions, including heavier or thicker materials, are not permitted without the written approval of Westlake Mechanical Integrity.

5.1.3 Reducers and swages are concentric unless otherwise noted.

5.1.4 Bends in welded piping shall be noted on the drawings with radius given for each. Care shall be taken to insure sufficient wall thickness for pressure temperature conditions where thinning may occur.

5.1.5 All welded attachments to pipe, fittings and flanges shall be of same material group as the pipe, fittings and flanges.

5.2 Material Receiving, Storing, and Delivery/Shipping

5.2.1 All materials and documentation will be inspected immediately upon receipt by Contractor QC Inspector to determine that all items included in the Bill of Materials have been supplied, to assure that all documentation has been received and to check for any damage.

5.2.2 All materials shall be requested or received as per pre-fabrication or erection sequence or site requirements as per the contractor Master Schedule which is agreed & approved by Westlake Mechanical Integrity.

5.2.3 The receiving materials or equipment found defective or presenting non-conformance that shall be clearly marked out and shall be returned to corresponding authority.

5.2.4 Material shall be stored at defined locations based on material classification.

5.2.5 Piping shall be pre-fabricated in as few pieces as possible, consistent with rail or truck shipment, to minimize field welding. The Contractor shall also identify field welds that are required due to handling and erection constraints.

5.2.6 Flange faces shall be covered with bolted or clamped protective covers. Both shop and field shall insure that flange faces are protected from corrosion or marring, with extreme care taken on RTJ and T&G flanges.

5.2.7 Beveled ends shall be protected by a securely fastened plastic end cover.

5.2.8 Threaded connections shall be protected by threaded metal caps or plastic plugs.

5.2.9 Each shipment shall be accompanied by a copy of the individual spool detail drawing of each piece contained in the shipment.

5.2.10 Large-sized fittings, flanges and valves shall be stored on wooden pallets and no material is allowed to rest or store directly on ground at all time.

5.2.11 All small-sized fittings, flanges and valves, and all of gaskets shall be stored on racks/shelves.

5.2.12 All bolts, washers and nuts shall be packaged and delivered in rigid, weatherproof containers.

5.2.13 Ensure the material is secured properly so that it does not fall, roll or move from its storage position. Pipes will be supported at bottom with kegs/ wooden blocks at least at three points and choked with wedges.

5.2.14 Materials stored in open areas will be barricaded and indicate the type of material and the hazard it poses, if any.

5.2.15 Coated pipe shall be handled at all times in a manner that prevents damage to the pipe walls (shall not be rolled or dragged on the ground).

5.2.16 Each length of pipe shall be examined to make sure it is free from internal obstructions and shall be air blown to remove dust and sand immediately prior to erection or welding.

5.2.17 Identification code shall be clearly marked on each plate, pipe and nozzle item by the Material Controller / Storekeeper.

5.3 Pre-Fabrication

5.3.1 Checklist for pre-fabrication of piping

5.3.1.1 Approval of Method Statement, Quality Plan and ITP

5.3.1.2 Approval of WPS covering all the material specifications.

5.3.1.3 Welder qualification list review and approval.

5.3.1.4 All the required Engineering drawings and documents are received in time.

5.3.1.5 All personnel and procedures for NDT, PWHT are approved.

5.3.1.6 Spool drawings marking field and shop weld joints shall be prepared, numbered and reviewed.

5.3.1.7 All tools, equipment and temporary items like pipe stands; pipe clamps etc. are ready in sufficient quantities.

5.3.1.8 Consumables shall be arranged in sufficient quantities as per the WPS.

5.3.1.9 Welding data base set up prior start of welding activities.

5.3.1.10 Procedure for handling and storage of consumables shall be issued.

5.4 Fabrication

5.4.1 Contractor's piping spool drawings shall conform to the piping drawings, isometrics and specifications.

5.4.2 All dimensions assume that the pipe shall be measured, cut and installed at a temperature of 70°F. The shop and field shall compensate for any variation in this temperature.

5.4.3 Piping 1-1/2" and smaller shall be field fabricated, or shop fabricated, at the Contractor's discretion.

5.4.4 The Contractor shall submit his welding procedures in accordance with the Welding section of this procedure

5.4.5 Cutting of pipes, fittings and edge preparation as per the drawing and WPS.

5.4.6 Marking should be done as per Isometric spool number measurement.

5.4.7 Based on spool breakdown of piping isometrics, pipe length shall be cut. Extra length for pipe shall be provided in spools for field adjustment.

5.4.8 Pipes shall cut using suitable method as per project requirement. Flame cutting of Stainless Steel is not allowed. Stainless steel shall be cut with Stainless Steel cutting disc. The edge cleaning and beveling shall be done using abrasive grinding disc.

5.4.9 The edges to be welded shall be prepared to meet the joint design requirements by any of the following method recommended:

5.4.10 Carbon Steel: Gas cutting, Machining or grinding methods shall be used. After gas cutting, oxides shall be smoothened / removed by chipping and grinding.

5.4.11 Alloy Steel: Gas cutting, Machining or grinding methods shall be used. After gas cutting, machining or grinding shall be carried out on the cut surface.

5.4.12 Stainless Steels, Nickel Alloys: Machining or grinding methods shall be used. After cutting, cut surface shall be machined or ground smooth.

5.4.13 Each shop fabricated spool shall be shown on a separate detail drawing and shall be assigned an individual piece number which includes the line number shown on the isometric drawing. Spool detail drawings shall list all materials used in fabrication.

5.4.14 Each spool shall have its piece number painted in large letters near one end immediately following fabrication. Prior to blasting and priming, a metal tag bearing the piece number shall be attached to the spool.

Spool Piece Mark Format:

2"-N-75712-AB-12

where

2"-N-75712-AB	=	line number
12	=	fabricator's piece number

5.4.15 Where a spectacle blind is called for on the drawings the Contractor shall drill, tap, and supply jack screws for flanges.

5.4.16 Slip on flanges, when specified, and reducing flanges shall be welded both inside and outside. If the inside weld extends beyond the face of the flange, it shall be ground flush. Flange faces shall be free from weld spatter, mars and scratches. Depth of recess shall be pipe thickness +1/8".

5.4.17 Orifice flange taps shall be oriented exactly as shown on the drawings, and the internal welds shall be ground smooth and flush. The sections of pipe to which the orifice flanges are attached shall be select pipe, smooth and free from blisters and scale.

5.4.18 Reinforcing pads shall be installed only where indicated on design drawings. Drawings will specify size and pad thickness. Basic plate material shall be the same as the pipe material unless otherwise approved in writing by Westlake.

5.4.19 Insulation shoes, anchors, guides, support clips, insulation anti slip bars, miscellaneous brackets and welded attachments shall be shop welded on heat treated alloy or stress relieved carbon steel pipe before heat treatment.

5.4.20 The Contractor shall provide insulation support saddles and structural "T" supports on all horizontal insulated lines at all supports, whether called for on the drawings or not.

5.4.21 The Contractor shall support insulation on all vertical lines at 15' intervals of uninterrupted vertical runs of pipe and provide support at all flanges in vertical runs of pipe to allow for removal of flange bolts.

5.4.22 Insulation supports for vertical lines shall consist of 3/16" thick plate rings welded to the pipe. The outside diameter of the rings shall be 1" less than the outside diameter of the insulation. Stainless plate shall be used for stainless pipe.

5.4.23 Unions are not allowed, use flanges.

5.4.24 The tolerances listed in the following paragraphs are permissible maximums but are more liberal than usual shop or field practice. These tolerances pertain to all piping including alloy. When closer tolerances are required, especially on alloy or stress relieved carbon steel, they shall be so noted on the drawings and shall not under any circumstances be exceeded.

5.4.24.1 General dimensions such as face to face, face or end to end, face or end to center, and center to center: + 1/8".

5.4.24.2 Flange bolt holes shall straddle the vertical or horizontal centerline unless otherwise noted. Rotation of flange bolt holes shall not exceed 1/16" measured across the flange face parallel to a centerline and between the holes nearest to it.

5.4.24.3 Inclination of flange face from true, in any direction: 3/64" per foot.

5.4.24.4 Displacement of branch connection from indicated location: + 1/16".

5.4.24.5 Tolerances shall not be cumulative.

5.4.25 Piping to be shop pickled will be so noted and specified on the drawings. The fabricator shall provide ample protection for all such piping to ensure that it will be free and clear from rust and corrosion until installed. All piping shall be prime painted in accordance with GES-601 “Painting and Protective Coatings”.

5.4.26 Prefabricated pipe shall be subject to inspection by a representative of Westlake Mechanical Integrity. Dimensional accuracy shall be subject to a check against the drawings.

5.5 **Erection**

5.5.1 All lifting tools, equipment and ropes used for erection shall be inspected and certified by Westlake HSE regulations. Activities shall be done according to the proper method statement for lifting and handling.

5.5.2 Pre-fabricated spools shall be shifted to site carefully; care shall be taken while handling and stacking of spools to prevent any possible damage.

5.5.3 The Pre-Fabricated spools shall be identified by spool and line numbers before erection.

5.5.4 Prior to erection the Contractor shall clean the inside of pipe spools of loose sand and dirt by blowing out with air or flushing with water.

5.5.5 The pre-fabricated supports shall be installed as per drawings, the pipe supports details shall be followed in the piping layout drawings and Isometric drawing for location and supports detail drawing.

5.5.6 All pipe openings shall be sealed before, during and after erection to prevent the ingress of moisture and foreign matter.

5.5.7 The Contractor shall make all field welds, field fit-up welds and all field checks.

5.5.8 The Contractor shall field check all dimensions as a part of the work covered in this specification. The field check is provided to compensate for discrepancies in equipment locations. The Contractor is responsible for compensating for minor discrepancies in distance between 2 fixed points.

5.5.9 Field fit up welds are shown by the symbol "FFU" on the drawings. Where a field fit up weld is required to join the ends of two pieces of pipe or a piece of pipe and a butt welding fitting or flange, the shop fabricated piece will have 4" of extra length of pipe with a plain end on one piece and an end beveled ready for welding on the adjoining piece. This extra 4" of length of pipe is provided at these points to compensate for minor discrepancies in equipment locations. The Contractor shall use this 4" for that purpose. This should be accomplished by starting piping installation at each fixed point and making a final field check at the point of the final fit up weld before installation of the final connection section.

5.5.10 Fit-up assembly and joint alignment shall be carried out, by using couplers or clamps

5.5.11 For butt welds a uniform root gap shall be maintained as per WPS.

5.5.12 For all socket weld joints the pipe end shall be free from cutting burrs, the axial gap between male and female component shall be maximum of 3 mm and minimum of 1.5 mm.

5.5.13 All cuts shall be carefully beveled and accurately matched to form a suitable preparation for welding and to permit full penetration of welds

5.5.14 Welding end plane shall be normal to the pipe axis as defined in the piping drawing.

5.5.15 Seam orientation of welded straight pipe and pipe to fittings shall be in such a way that, circumferential angle between seam is at an angle of 30°.

5.5.16 The pipes shall be tack-welded in equidistant positions to avoid cracking and bending or joint during welding. Tack weld shall be done by a qualified welder as per approved WPS.

5.5.17 All field welds which result from shipping, handling or erection constraints shall also be made by the Contractor. A minimum number of field welds are preferred.

5.5.18 A clearance of 1/16" shall be maintained between the end of the pipe and the shoulder of socket on socket weld fittings when socket weld joint is made.

5.5.19 Branch connections, vent nozzles, trunnions and other attachments including reinforcing pads shall not be welded over or near longitudinal or circumferential welds in the piping.

5.5.20 All flanged joints shall be bolted up according to GSM-MP-GEN-005 “Torqueing” procedure. All requirements for flanges, gaskets, bolts, washers, etc. and assembly in that procedure must be following.

5.5.21 The flange faces shall be square to the pipeline in which they are fitted.

5.5.22 The fit up of pipe ends and weld neck flanges shall be done to obtain uniform root opening. The criteria given in related WPS shall be followed.

5.5.23 Valves shall be oriented in the line so as to be readily operable. Gate and globe valves in horizontal lines shall be installed with their stems oriented as follows, in order of preference:

5.5.23.1 Vertically upward.

5.5.23.2 Horizontal preferred for chain operated.

5.5.23.3 Upward at 45º

5.5.23.4 Downward at 45º

5.5.23.5 Vertically downward avoid if possible.

5.5.24 Steel to cast iron flanged joints shall be made up with extreme care, taking up on bolts uniformly after bringing flanges up flush with gasket and fitting into close parallel and lateral alignment. This is essential to avoid breakage of cast iron flanges. Steel flanges mating to cast iron flanges shall be flat faced.

5.5.25 Flanged Equipment Connections:

5.5.25.1 A flange cover shall be kept on all flanged connections to pumps, compressors, turbines and similar equipment, until ready to connect the piping. In connecting this piping, a test blank shall be installed and left in place until piping testing is complete. See GES 2-1-3.

5.5.25.2 Flanges connecting to mechanical equipment, such as pumps, turbines, or compressors, shall be fitted up in close parallel and lateral alignment prior to tightening the bolting. Carbon steel pipe may be heated at these points for minor corrections in fit but may not be water quenched. Alloy steel or nonferrous pipe shall not be heated without Westlake Mechanical Integrity approval

5.5.26 Orifice Plates:

5.5.26.1 Orifice plates, flow nozzles, or other in-line inserts shall not be installed until completion of all hydrostatic testing on the unit.

5.5.26.2 A record of all orifice plates on each unit shall be submitted to Westlake Mechanical Integrity for approval prior to installation of the plates. This list shall include instrument identification numbers, and orifice bores measured to the nearest 0.001".

5.5.27 Underground Pipe:

5.5.27.1 Prior to lowering the pipe line, supervisor and surveyor shall ensure the trench excavation is as per approved drawing, trench bottom shall be firm and give inform support for the pipe and that all foreign material, debris sharp object that will be harmful to pipeline coating shall be removed.

5.5.27.2 Ditches shall not be back filled until after inspection and approval of the piping by Westlake.

5.5.27.3 Ditches for underground pressure piping shall not be back filled until after hydrostatic testing and inspections by Westlake. If approved by Westlake Mechanical Integrity, pipe between joints may be back filled prior to testing, in order to facilitate other work.

5.5.27.4 After the execution of tests, cleaning, protection, inspection and eventual repairs, the piping network shall be covered up.

5.5.28 Pipe Supports:

5.5.28.1 Wherever possible, pipe supports should be designed such that no part of the structural support is attached to a pressure containing boundary by welding. Alternatively, Clamp-on style shoes are preferred.

5.5.28.2 In addition to major supports specified by the design drawings, minor supports as found necessary in the field shall also be installed to prevent undesirable vibration, sag, lateral movements, or stresses, or as required by Westlake, for a complete installation.

5.5.28.3 If pipe supports must be attached by welding, a re-pad is required. The pipe support should never be welded directly to the piping system. Welding preparations for the pipe to pipe supports and structural steel welding for pipe supports shall be in accordance with corresponding WPS.

5.5.28.4 All pipe support shall be individually identified by number and this number shall be marked on the piping layout plans.

5.5.28.5 Supports include bearing supports, hangers, guides, bracing and anchors.

5.5.28.6 Spring hangers, including constant support hangers, shall be checked for proper adjustment of travel, and correctly positioned for the cold condition at erection. Factory set hangers shall be located per support identification number and travel position checked after installation.

5.5.29 Guides shall be of type and as shown on drawings. Guides shall be positioned to restrict lateral movement of straight runs without impairing the flexure of bends or loops.

5.5.30 Corrugated and packed expansion joints shall be installed with length extended or compressed for the cold condition at erection depending on anticipated direction and magnitude of movement after line reaches operating temperature.

5.5.31 Painting:

5.5.31.1 Painting shall be in accordance with GES-601 “Painting and Protective Coatings”.

5.5.31.2 Non sandblasted pipe welds (for example: butt welds, nozzle welds, socket welds, slip on flange welds, attachment welds) shall be power brushed for burnt flux removal and touched up in accordance with GES-601.

5.6 Testing and Checkout

5.6.1 In general, hydrostatic testing shall be performed before piping is completely installed. Additional drains and vents not shown on the drawings but required to facilitate testing, draining and flushing of piping, shall be installed by the Contractor.

5.6.2 Suitable NDT (DPT, RT, etc.) shall be carried out for weld joints as per approved procedure and the results shall be recorded.

5.6.3 Prior to operation, the following checks shall be made to assure that piping items are ready for operation:

5.6.4 Check that chain wheels or chain wrenches are provided wherever necessary for valve operation.

5.6.5 Install any supplementary platforms or ladders that may be required by Westlake access to valves.

5.6.6 Check packing glands for quantity and type of packing and add packing if required. Any valves in which gland temperature may exceed 750°F may require special packing.

5.6.7 Check plug valves for quantity and type of lubricant. Standard lubricant furnished by vendor may require replacement to conform with Westlake standards for special service.

5.6.8 All permanent pipe plugs shall be checked to see that bar stock plugs have been used. Any such plugs of other design furnished with piping items shall be replaced.

5.6.9 When steam traps are put in operation, steam traps shall be checked for operability and repaired as required.

5.6.10 Check that safety shields are installed on stuffing boxes and flanged joints for acids, caustic, or other dangerous services as designated by Westlake.

5.7 All WPS/PQR shall be approved by Westlake Mechanical Integrity prior to use at this facility.

5.8 Materials used shall be according to the piping specification on the drawings and line index.

5.9 Any gasket or other product chosen that is considered an equivalent must be approved by Westlake Engineering.

5.10 Dimensions, tolerances, rating, testing and marking for wrought carbon and alloy steel factory made components shall conform to the following:

Piping	ASME B36.10M / ASME B36.19M
Buttweld Fittings	ASME B16.9 / ASME B16.28
Forged Socket Weld Fittings	ASME B16.11
Forged Screwed Fittings	ASME B16.11
Flanged Valves	ASME B16.10 / ASME B16.34
Buttweld Valves	ASME B16.10 / ASME B16.34
Swage Nipples and Bull Plugs	MSS SP-95
Socket Weld Valves	ASME B16.34
Flanges	ASME B16.5 / ASME B16.47
Orifice Flanges	ASME B16.36
Non-metallic Gaskets	ASME B16.21
Metallic Gaskets	ASME B16.20

6 WELDING

6.1 Acceptable Welding Processes

6.1.1 Acceptable welding processes are manual shielded metal arc, manual or automatic gas tungsten arc, automatic submerged arc, gas metal arc, and flux core arc welding. Suitable combinations of these processes may be employed. The process or combination of processes used in any given instance is subject to Westlake Mechanical Integrity approval.

6.1.2 No gas metal arc welding (GMAW) other than spray transfer mode is permitted on pressure containing welds unless authorized in writing by Westlake.

6.1.3 Semi-automatic submerged arc welding shall not be used on pressure or strength welding except when the joint is 100% radiographically examined.

6.1.4 Metal deposited by submerged arc welding shall not be in layers exceeding 3/8" in depth.

6.1.5 Downhill welding is not acceptable unless approved by Westlake Mechanical Integrity in writing.

6.1.6 Procedures for welding dissimilar materials shall be submitted to Westlake Mechanical Integrity for approval.

Carbon Steel and Carbon 1/2 Moly		
Sch 40 pipe size:	***Type of Weld***	***Welding Process***
1/2'' and Under	Socket or Back Weld	GTAW
3/4'' - 1 1/2''	Socket or Back Weld	SMAW, GTAW+SMAW
Under 2''	Butt Weld	GTAW OR GTAW+SMAW
2'' - 4''	Butt Weld	SMAW, GTAW, GTAW+SMAW, FCAW, GMAW
6'' - 24''	Butt Weld	SMAW, GTAW, GTAW+SMAW, SMAW+SAW, FCAW, GMAW
Sch 80 pipe size:	***Type of Weld***	***Welding Process***
1/2'' and Under	Socket or Back Weld	GTAW
3/4'' - 1 1/2''	Socket or Back Weld	SMAW, GTAW+SMAW
Under 11/2''	Butt Weld	GTAW, OR GTAW+SMAW
1 1/2'' - 3''	Butt Weld	SMAW, GTAW, GTAW+SMAW,
4'' - 24''	Butt Weld	SMAW, GTAW, GTAW+SMAW, SMAW+SAW, FCAW, GMAW
Sch 160 pipe size:	***Type of Weld***	***Welding Process***
3/8'' - 1 1/2''	Socket or Back Weld	SMAW, GTAW
Under 1''	Butt Weld	GTAW
1'' - 4''	Butt Weld	SMAW, GTAW, GTAW+SMAW, FCAW, GMAW
6'' - 24''	Butt Weld	SMAW, GTAW, GTAW+SMAW, SMAW+SAW, FCAW, GMAW
Plate used for piping attachments:	***Type of Weld***	***Welding Process***
Under 5/32''		GTAW
5/32'' - 3/8''		SMAW, GTAW, GTAW+SMAW, SMAW+SAW, FCAW
Over 3/8''		SMAW, GTAW, GTAW+SMAW, SMAW+SAW, FCAW

Chrome Moly Steels 1 through 9% Chrome		
Sch 40 pipe size:	***Type of Weld***	***Welding Process***
1/2'' and Under	Socket or Back Weld	GTAW
3/4'' - 1 1/2''	Socket or Back Weld	SMAW, GTAW
Under 2''	Butt Weld	GTAW
2'' - 4''	Butt Weld	GTAW, GTAW+SMAW
6'' - 24''	Butt Weld	GTAW, GTAW+SMAW, SMAW+SAW
Sch 80 pipe size:	***Type of Weld***	***Welding Process***
1/2'' and Under	Socket or Back Weld	GTAW
3/4'' - 1 1/2''	Socket or Back Weld	SMAW, GTAW
Under 1 1/2''	Butt Weld	GTAW
1 1/2'' - 4''	Butt Weld	GTAW, GTAW+SMAW
6'' - 24''	Butt Weld	GTAW, GTAW+SMAW+SAW
Sch 160 pipe size:	***Type of Weld***	***Welding Process***
1/2'' - 1 1/2''	Socket or Back Weld	SMAW, GTAW
Under 1 1/2''	Butt Weld	GTAW
1 1/2'' - 4''	Butt Weld	GTAW, GTAW+SMAW
6'' - 24''	Butt Weld	GTAW+SMAW, SMAW+SAW
Plate used for piping attachments, including under 12 Chrome:	***Type of Weld***	***Welding Process***
Under 5/32''		GTAW
5/32'' - 3/8''		SMAW, GTAW, GTAW+SMAW, SMAW+SAW
Over 3/8''		SMAW, GTAW, GTAW+SMAW, SMAW+SAW

Austenitic Chrome Nickel Steels and Types 405, 410 and 430		
Sch 5 and 10 pipe size:	***Type of Weld***	***Welding Process***
Under 2''	Socket or Back Weld	GTAW
Sch 5 2'' - 12''	Butt Weld	GTAW+Purge
Sch 10 2'' - 12''	Butt Weld	GTAW+Purge+SMAW
Sch 40 pipe size:	***Type of Weld***	***Welding Process***
Under 3/4''	Socket or Back Weld	GTAW
3/4'' - 1 1/2''	Socket or Back Weld	SMAW, GTAW
Under 2”	Butt Weld	GTAW+Purge
2'' - 4''	Butt Weld	GTAW+Purge, GTAW+Purge+SMAW
6'' - 12''	Butt Weld	SMAW, GTAW+Purge, GTAW+Purge+SMAW
Sch 80 pipe size:	***Type of Weld***	***Welding Process***
Under 1/2''	Socket or Back Weld	GTAW
1/2'' - 1 1/2''	Socket or Back Weld	GTAW
Under 2''	Butt Weld	GTAW+Purge
2'' - 4''	Butt Weld	GTAW+Purge, GTAW+Purge+SMAW
6'' - 24''	Butt Weld	SMAW, GTAW+Purge, GTAW+Purge+SMAW, SMAW+SAW
Plate used for piping attachments:	***Type of Weld***	***Welding Process***
Under 5/32''		GTAW
5/32'' - 3/8''		SMAW, GTAW, GTAW+SMAW
Over 3/8''		SMAW, GTAW, GTAW+SMAW, SMAW+SAW

Monel, Nickel, Inconel and Incoloy		
Sch all pipe sizes:	***Type of Weld***	***Welding Process***
Under 3/4''	Socket or Back Weld	GTAW
3/4'' - 1 1/2''	Socket or Back Weld	GTAW
Sch 10 pipe size:	***Type of Weld***	***Welding Process***
Under 8''	Butt Weld	GTAW+Purge, GTAW+Purge+SMAW
8'' and Over	Butt Weld	GTAW+Purge, GTAW+Purge, SMAW
Sch 40 pipe size:	***Type of Weld***	***Welding Process***
Under 2 1/2''	Butt Weld	GTAW+Purge
2 1/2'' - 4''	Butt Weld	GTAW+Purge, GTAW+Purge+SMAW
6'' - 24''	Butt Weld	GTAW+Purge, GTAW+Purge+SMAW, SMAW+SAW (2)
Sch 80 pipe size:	***Type of Weld***	***Welding Process***
Under 2''	Butt Weld	GTAW+Purge
2'' - 4''	Butt Weld	GTAW+Purge, GTAW+Purge+SMAW
6'' - 24''	Butt Weld	GTAW+Purge, GTAW+Purge+SMAW, SMAW+SAW (2)
Plate used for piping attachments:	***Type of Weld***	***Welding Process***
Under 5/32''		GTAW (1)
5/32'' - 3/8''		SMAW, GTAW (1), GTAW (1) + SMAW
Over 3/8''		SMAW, GTAW (1), GTAW (1) + SMAW, SMAW+SAW
(1) If single welded, purge underside.		
(2) For shop welding only; 100% X-Ray required.		

Aluminium		
Pipe size :	***Type of Weld***	***Welding Process***
All sizes	Socket and Back Weld	GTAW
All sizes	Butt Weld	GTAW (1)
Plate used for piping attachments:	***Type of Weld***	***Welding Process***
Under 5/32''		GTAW (1)
5/32'' and Over		GTAW (1)
(1) If single welded, purge underside.		

6.1.7 One copy of all certified qualification procedures to be used by the Contractor shall be furnished to Westlake Mechanical Integrity for approval prior to any welding operations.

6.1.8 Welder Qualification Requirements:

6.1.8.1 All welding shall be done by welders qualified in accordance with ASME Section IX by a Westlake approved independent testing laboratory. The Contractor shall provide Westlake with a copy of each welder's performance qualification.

6.1.8.2 In accordance with ASME Section IX, requalification is required when there is specific reason to question the welder's ability to make welds that meet the specifications.

6.1.8.3 All field and shop welders must be certified in accordance with the welding procedure qualification by which they are working.

6.1.8.4 All field and shop welders must be properly certified by the contractor for whom they are currently employed.

6.1.8.5 All tack welds on pipe or pressure vessels shall be made by personnel who are properly qualified to perform such tasks.

6.2 **Filler Materials**

6.2.1 Analysis of the deposited weld metal, in the principal alloys, shall meet the analysis range of the base material. In dissimilar metal joints of ferrous metals, the higher analysis of the metals joined shall be met.

6.2.2 Comparable low carbon austenitic filler materials shall be used with the low carbon grade of austenitic base materials.

6.2.3 Electrodes and filler wires shall be kept clean, dry and properly stored and conditioned for use according to the manufacturer's recommendations. Coated electrodes use for filed welding kept in Bare conditions.

6.2.4 No electrodes or filler wires may be used which are damp, greasy or oxidized.

6.3 **Welding Equipment**

6.3.1 All welding equipment shall be in good condition and properly maintained and capable of providing proper currents and voltages at the arc.

6.3.2 D.C. welding machines rated at less than forty volts shall not be used.

6.4 **Fit-Up and Joint Preparation**

6.4.1 Back-up rings shall not be used.

6.4.2 Tack welds sufficient to position the work may be used unless specifically prohibited. No tack shall be longer than 1". Tack welds shall have good penetration, tie into sides of the bevel and taper down at each end to insure as good a tie-in as possible. Such tacks shall be of quality sufficient for incorporation into the weld. If tacks do not meet these requirements, they shall be removed cleanly by whatever method is appropriate for the material.

6.4.3 The welding face shall be prepared in such a way that the it must be cut and ground smoothly and the imperfections (Slots, spatters, surface oxide due to cutting and rusting) shall be removed from the welding area.

6.4.4 All materials to be welded shall be properly positioned with correct fit-up before welding is started. The base metal, to a distance of one metal thickness with a minimum distance of 1", shall

be cleaned of all dirt, grease, scale, and other foreign matter which would be detrimental to the weld quality.

6.4.5 The ends of piping components to be joined shall be aligned as accurately as is practicable within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness. Alignment shall be maintained during welding. Where ends are to be joined and the internal misalignment exceeds 1/16", it is preferred that the component with the wall extending internally be internally trimmed, so that adjoining internal surfaces are approximately flush. However, this trimming shall not result in a piping component wall thickness less than the minimum design thickness plus corrosion and erosion allowances.

6.5 **Welding of Joints**

6.5.1 Only welders qualified to weld in all positions shall be allowed to weld pipe.

6.5.2 Welding shall be done as per approved WPS and ITP for the particular piping. Pre heating and welding consumables shall be checked before starting of welding.

6.5.3 The oxy-acetylene process shall not be used for welding butt-welded or socket welds.

6.5.4 Each pass shall be made completely around the pipe before a subsequent pass is made.

6.5.5 Nozzles, couplings, and reinforcing pads may be welded by using stringer passes.

6.5.6 All branch connections shall be joined to headers with full penetration welding. The bore side shall be ground smooth, free from cracks.

6.5.7 No weave pass with other than cellulose covered electrode EXX10 or EXX11 is to be made more than three electrode diameters wide.

6.5.8 Starting and stopping points of beads shall be staggered.

6.5.9 Detrimental visible defects, flux, scale, and excessive spatter shall be removed from each pass before laying down a subsequent pass as well as from the cover pass.

6.5.10 The welding work piece shall be shielded against high winds and rain.

6.5.11 Excess root reinforcement of pipe welds shall be held to a minimum and not exceed 1/8".

6.5.12 Heating for straightening shall be subject to approval by Westlake. Quenching of spot heats is not permitted

6.5.13 Peening in excess of that required to clean welds shall not be permitted.

6.5.14 Removal of defects and cleaning of austenitic stainless steel, and high nickel alloys shall be with aluminum oxide grinding wheels and stainless steel wire brushes. These tools shall not have been previously used on other than the type materials being cleaned.

6.5.15 Cracks of any size, either inside or outside a weld, are prohibited and are cause for rejection.

6.5.16 Projections of weld metal into the pipe bore at welded butt joints shall not exceed 1/8" (as measured on the side of the joint giving the smaller dimension). Excessive projection on accessible joints shall be removed by grinding. Objectionable depressions on the inside of the weld on accessible joints shall be corrected by welding and grinding.

6.5.17 Gaps or incomplete penetration in the first pass of a weld are causes of rejection.

6.5.18 All welds shall have 100% penetration to the root of the joint. The root gap of butt-welds shall be such as to permit consistent full penetration. Lack of penetration on accessible joints may be corrected by welding on the inside.

6.5.19 Where seal welding of threaded joints is specified, the threads shall be made up dry. The weld shall cover all exposed threads. A maximum of three threads shall be exposed, prior to welding.

6.5.20 All finished welding shall be power-brushed for burnt flux removal using wire wheels compatible with the base metal being cleaned.

6.5.21 Appearance of finished welds shall be as even as possible and free from spatter, under cut, cracks, excess reinforcement etc. with reference to ASME B31.3 and relevant WPS.

6.5.22 The back side of double butt welded joints made by manual welding shall be chipped, gouged, ground or machined to sound metal and magnifluxed before depositing additional metal. When magnetic particle examination cannot be used, the dye penetrant method shall be employed. The method used for removing the defects shall be appropriate for the material.

6.5.23 Each welder shall be assigned a symbol and shall identify each joint he welds by writing his symbol adjacent to the weld. If more than one welder works on a weld, the identification of the welder making the first pass or passes shall be nearer to the weld. The welder completing the weld shall stamp his symbol farther out and next to the stamp of the first welder.

6.6 Preheating

6.6.1 Preheat for the various grades of materials shall be in accordance with the specified Welding Procedures and Specifications.

6.6.2 Wet joints shall be dried by burner heating for a distance of 4-5 inches from the weld joint and shall be warm to the hand before starting welding, unless a greater pre-heat temperature is required.

6.6.3 Temperature-indicating crayons, thermocouples, or calibrated contact pyrometers shall be used to measure preheat and interpass temperatures.

6.6.4 The preheat temperature shall be established over a minimum distance of 3 inches on each side of the weld.

6.7 Post-weld Heat Treatment (PWHT)

6.7.1 If PWHT is applicable for any piping system, PWHT procedure shall be developed and strictly followed.

6.7.2 The PWHT table shall include the following information for each joint or component:

- 6.7.2.1 Location
- 6.7.2.2 Drawing number
- 6.7.2.3 Diameter
- 6.7.2.4 Wall thickness
- 6.7.2.5 Material
- 6.7.2.6 Heating rate and cooling rate
- 6.7.2.7 Soak temperature
- 6.7.2.8 Soak time

6.7.3 It shall be the responsibility of the employed PWHT operator to ensure personal safety & to ensure whether the facilities with respect to scaffolding, lighting, etc. are sufficient, before commencement of any job. All cables shall be tied up neatly to avoid damage to cables & personnel injuries to operators.

6.7.4 Before starting the Heat Treatment process, the assigned contractor shall submit the documents citing heating and cooling methods, temperature measuring and recording methods; for the approval of QA/QC department.

6.7.5 All thermocouples and temperature recorders shall be calibrated and checked periodically.

6.7.6 All machined surfaces shall be protected from oxidation during the heat treatment by suitable coating material.

6.8 **Welding Inspection**

6.8.1 Inspection shall begin soon as practicable after fabrication has started.

6.8.2 The Contractor shall notify Westlake five (5) days in advance of the start of fabrication.

6.8.3 For any radiographic, or dye penetrant testing, Westlake shall retain an independent testing laboratory. All or any number of welds made by the Contractor may be submitted to 100% X-Ray in accordance with ASME B31.3, and the additional requirements listed in Table II. The percentage indicated shall be the total number of butt welds to be 100% radiographed, and shall be graded on a 100% basis, except as noted on the line list. Westlake's inspector will make the selection of welds to be radiographed. If in Westlake’s opinion, the welds do not meet the requirements of ASME B31.3, they shall be removed and rewelded. Repaired areas shall be re-radiographed.

6.8.4 All repair radiographs shall be so identified. The first repair shall be identified by an "R" after identification number; the second repair by "R2", etc.

6.8.5 Westlake reserves the right to request radiographic examination in addition to that called for in this specification.

6.8.6 Hardness testing of production welds is only required if specified.

6.8.7 The hardness indentations shall be made at or near the middle of the deposited weld bead and HAZ if specified.

7 FLUID SERVICE CATEGORIES

7.1 The table below shows how various services are classified at Westlake Geismar according to ASME B31.3. For any service not listed under these categories, consult Westlake Mechanical Integrity for appropriate classification.

7.2 For Category D services, if the pressure/temperature conditions of the line exceed the Category D requirements in ASME B31.3, the service must be considered Normal fluid service.

Category M	Normal (PSM Covered)	Normal	Category D
2ME	EDC	Air Evacuation	Breathing Air
Chlorine (Dry, Wet, Gas)*	Ethylene	Anti-Foam	Instrument Air
Quench Liquid	Glycerin	Boiler Blow Down	Nitrogen
Reactor Slurry	Glycol	Boiler Feed Water	Plant Air
REK	H2 Gas	Brine	Potable Water
RVCM	H2 Gas Cond.	Brine Eva Cond.	
VCM	HCL	Catholyte	
	Hydrogen Chloride	Caustic	
	Intermediate Feed Stock	Caustic Eva Cond.	
	Make-Up Coating	Clarified Water	
	Oxygen	Cooling/Chilled Water	
	Propylene	Demin/DI Water	
	PVA (Poly Vinyl Alcohol)	Evacuation and Purge	
	PVC Slurry	Fire Water	
	Termination Solution	Low Pressure Header	
		Natural Gas	
		Refrigerant	
		Rinse Water	
		Seal Oil	
		Service Water	
		Sodium Bisulfite	
		Sodium Hypochlorite	
		Sodium Nitrate	
		Steam	
		Steam Condensate	
		Sulfuric Acid	
		Vent Crosstie	
		Waste Water	
		Wet Vent Line	

**All welds must meet severe cyclic service acceptance criteria per ASME B31.3*

8 NDE REQUIREMENTS

8.1 The table below shows the minimum NDE requirements for fabricated piping containing the various fluid service categories.

Service Category	Radiography [A]	Visual Inspection	Liquid Penetrant [F]	Material Verification	Hydrostatic Leak Test [B]	Sensitive Leak Test	Ferrite Testing
Category M	100%	100%	100%	Note D	R	R	Note G
Normal (PSM Covered)	20%	100%	100%	Note D	R	NR	Note G
Normal	5%	100%	25%	Note D	R	NR	Note G
Category D	N/A	100%	N/A	N/A	Note C	NR	N/A

R = Required NR = Not Required

Notes

A. Applies to circumferential and miter groove welds. Welds shall be selected so that each welder's work is represented and maximizes coverage of intersections with longitudinal joints. A minimum of 1.5" of intersecting joints shall be examined.
B. When hydrostatic testing is deemed impractical by the owner, and conditions in Par. 345.1(c) are met, the following alternative may be substituted, at the sole discretion of the Westlake Mechanical Integrity Department: All circumferential, longitudinal, and spiral groove welds shall be 100% radiographed or 100% ultrasonically examined. All welds, including structural attachment welds not covered above, shall be examined using the liquid penetrant or magnetic particle method.
C. Initial service leak test may be substituted for hydrostatic leak test with Westlake Mechanical Integrity approval. Process or service leak test must be witnessed and documented and contain a verifiable means by which pressure may be established and verified.
D. Obtain material test reports for carbon and low alloy steel piping and components. Positive material identification required on alloys and exotic materials.
E. Each welder and/or welding operator shall be represented. Percentages are applicable per line per service per package per welder.
F. Applies to branch, fillet, and socket weld connections.
G. Ferrite number testing: 10% for austenitic stainless steels. 100% for Duplex stainless steels. (as welded)

9 FIELD PRESSURE TESTING OF PIPING

9.1 General

9.1.1 As a general rule, equipment should be tested prior to installation and only in special circumstances be tested as part of a piping system.

9.1.2 Instruments shall not be tested with piping systems, except in-line control valves which must be in the open position during testing. Instrument piping shall be tested separately from the process piping by the Instrumentation Contractor and should adhere to GES-2041 "Specification for Instrumentation Design".

9.1.3 The following equipment and components should be removed from system by blinding, air gapping or other safe means.

9.1.3.1 Rotary equipment such as pumps, compressors and turbines.

9.1.3.2 Safety valves rupture discs, flame arresters, and steam traps.

9.1.3.3 Pressure vessels.

9.1.3.4 Equipment and piping lined with refractories.

9.1.3.5 Storage tanks.

9.1.3.6 Filters, strainers.

9.1.3.7 Heat exchangers of which tube sheets and internals have been designed for differential pressure between tube side and shell side.

9.1.3.8 Instruments such as orifice and flowmeters.

9.1.3.9 Any package unit previously tested by the manufacturer in accordance with the applicable codes.

9.1.3.10 Instrument impulse lines

9.1.4 This specification prescribes pressure tests to be performed over a short duration when construction of a unit is substantially complete to confirm the mechanical strength and soundness of the erected piping systems.

9.1.5 This specification shall be used in conjunction with line lists showing the test pressure.

9.1.6 The pressure tests shall be performed on the basis of minimum use of blind flanges (i.e., maximum system test).

9.1.7 Vent, drain, relief or blowdown header systems which are open to the atmosphere shall not be hydrostatically pressure tested unless specifically requested by Westlake. The vent, drain or blow down valves should be open for the test with their discharges plugged or blind flanged.

9.1.8 All sprinkler piping shall be flushed and then plugged for pressure testing; heads, rosettes and nozzles shall be fitted after pressure testing.

9.1.9 Where the design of a piping system is such to make hydrostatic testing of a system impractical or objectionable, a pneumatic test may be substituted with Westlake Mechanical Integrity approval.

9.1.10 Low pressure (150 psig and under) utility lines may be tested with the service commodity at the discretion of Westlake.

9.2 **Testing Medium**

9.2.1 Liquids:

9.2.1.1 Fresh water (less than 30 ppm chloride content) shall be used, unless other water is approved by Westlake Mechanical Integrity. When water is detrimental to a piping system, a substitute media will be specified.

9.2.1.2 The water used in testing austenitic stainless steel systems shall contain less than 50 ppm chlorides. Westlake will advise the Contractor of a source for this water.

9.2.1.3 Testing when ambient temperature is below 32°F must be avoided if possible. When testing must be done at ambient temperatures below 32°F, provision must be made to prevent freezing. The addition of antifreeze to the water or the use of a liquid other than water is acceptable. The substitution of another fluid shall be in accordance with Paragraph 337.2 of ANSI B31.3. All fluid substitutions must be approved by Westlake Mechanical Integrity. Alternatively, Heated Water can be circulated through the test section for several hours until the temperature of the pipe and surrounding ground reach below 32°F.

9.2.1.4 Drinking water systems shall only be tested with potable water.

9.3 **Test Pressure**

9.3.1 Piping line index will show test pressures and test medium.

9.3.2 Large vapor or gas piping that cannot be supported when full of water will be identified with test requirements indicated on the line list.

9.3.3 For piping designed for internal pressure, for a design temperature above the test temperature, the minimum test pressure shall be as calculated by the following equation:

$$P_t = \frac{1.5 * P * S_t}{S}$$

P_t = Minimum calculated hydrostatic test pressure

P = Internal design pressure

S_t = Allowable stress at test temperature

S = Allowable stress at design temperature

9.3.4 Where test pressure as defined above would produce a stress in excess of the specified minimum yield strength at test temperature, the test pressure shall be reduced to a pressure at which the stress will not exceed the specified minimum yield strength at the test temperature.

9.3.5 The maximum test pressure at which the stress produced will not exceed the specified minimum yield strength may be calculated by the following equation:

$$P_m = \frac{2S * E * t}{D}$$

P_m = Maximum test pressure

S = Specified minimum yield strength at test temperature

T = specified pipe wall thickness minus mill tolerance

D = outside diameter

E = Quality factor (see ASME B31.3, Table A-1 B)

9.3.6 The maximum test pressure for open valves shall not exceed 1.5 times the 100°F rating rounded off to the next higher 25 psi increment. Refer to ASME B16.34.

9.3.7 The maximum test pressure for flanges shall not exceed 1.5 times the 100°F rating rounded off to the next higher 25 psi increment. Refer to ASME B16.5.

9.3.8 The maximum test pressure for closed valves shall not exceed 1.1 times the 100°F rating. Refer to ASME B16.34. Seats of iron valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve.

9.3.9 It will generally be necessary to blank out vessels even though the test pressure does not exceed the vessel allowable.

9.3.10 Piping systems in externally pressured and vacuum service shall be hydrostatically tested at 1.5 times the external differential design pressure but not less than a gauge pressure of 15 psig unless limited to lower pressure by the design.

9.3.11 For jacketed lines, the jacket shall be tested in accordance with the line list on the basis of jacket pressure. The internal line shall be tested on basis of external or internal pressure, whichever is critical, unless limited by the design.

9.4 **Construction**

9.4.1 Safety

9.4.1.1 During pneumatic testing, Westlake operations shall barricade the area and clear it of all personnel not involved in the test to avoid unnecessary exposure of personnel to danger.

9.4.2 Preparation for Test

9.4.2.1 When piping systems are installed and ready for the hydrostatic test the following preparations shall be made before water is introduced into the system:

9.4.2.2 Piping systems shall be water flushed prior to test. Water flushing of lines shall be done in such a manner that the maximum volume and velocity can be reached in the lines to assure that the best possible job of flushing is accomplished. The Contractor shall submit a flushing plan to Westlake Mechanical Integrity for approval.

9.4.2.3 Blind flanges, blanks, caps or plugs shall be installed to isolate piping systems, equipment and instruments.

9.4.2.4 Flanged joints shall be prepared for pneumatic testing by swabbing with a solution of 50% by volume of water and dishwashing detergent.

9.4.2.5 Piping supported by counter weighted or spring supports without "down travel stops" shall be temporarily blocked up to support the line plus the weight of the water. Spring supports with "down travel stops" should have the stops inserted prior to filling for test. The "stops" shall be red tagged and stops and tags shall be removed after the completion of the test and the water has been drained from the system.

9.4.2.6 Piping in gas or vapor service with supports that are not strong enough to support the piping full of water shall be blocked up temporarily prior to the test and the blocks shall be removed after the test and draining. Large vapor or gas piping that cannot be supported when full of water will be identified on the be tested as indicated by the Line List.

9.4.2.7 All joints, including welds, are to be left uninsulated and exposed for examination during the test. If a joint has been previously tested in accordance with this specification, it may be insulated or covered.

9.4.2.8 Expansion joints shall be provided with temporary restraint, if required, for the additional pressure load under test or shall be isolated from the test.

9.4.2.9 Where a system is to be isolated at a pair of companion flanges, a blank shall be inserted between the companion flanges. Open ends of piping systems where blanks cannot be used, such as pumps, compressors, turbines or wherever equipment or pipe spools have been removed or disconnected prior to hydrostatic testing, shall be blinded off using standard blind flanges of the same rating as the piping system being tested. Minimum thicknesses of blanks shall be calculated as shown below:

$$t = d\sqrt{\frac{3P}{16SE}}$$

t = minimum blank thickness, inches
d = inside diameter of gasket, inches
P = test pressure, psig
SE = allowable stress for blank material, psi

9.4.2.10 Lines containing check valves shall have the source of pressure located in the piping upstream of the check valve so that pressure is applied under the seat. If this is not possible, the check valve flapper shall be removed and tagged. The tag is to be removed only after the flapper has been replaced.

9.4.2.11 Instrument piping shall not be tested with the piping system. The instrument lead shall be disconnected and the valve, plugged and left open during the test.

9.4.2.12 All piping systems to be hydrostatically tested shall be vented at the high points (also drains open at low points for the initial flushing) and the system purged of air before the test pressure is applied. Vent and drain valves shall be open with discharge end plugged or blanked for test.

9.4.2.13 Temporary gaskets may be used which are not the same as permanent gaskets provided such use does not lead to damage of the flange faces.

9.4.2.14 No equipment/instrument that is part of permanent works shall be used as a part of pressure testing equipment (i.e. pressure gauges, valves, etc.)

9.4.3 Testing Procedures

9.4.3.1 It is desirable to pressure test at one time as much pipe as is possible without exceeding the allowable test pressure of the weakest element in the system. The Contractor may test in smaller segments to facilitate construction. Test system configuration shall have Westlake Mechanical Integrity approval prior to start of testing.

9.4.3.2 Systems or sections of systems to be tested may be isolated by closed valves provided the valve seat is suitable for test pressure.

9.4.3.3 Where a valve is not suitable, vessels, equipment or other piping not included in the system to be pressure tested shall be disconnected from the system or isolated by blinds or other means during the test.

9.4.3.4 All test pressures shown on line lists are calculated for the test pressure gage to be located at grade. However, test pressure readings may be taken at other points of a line or system of

lines, providing static head is deducted from test pressure shown when determining the allowable test pressure. In any case, care shall be taken to avoid over stressing any of the equipment in the lower portion of the system while testing.

9.4.3.5 Test pressure shall be applied by means of a suitable test pump or other pressure source which shall be isolated from the system until ready to test. A pressure gauge shall be provided at the pump discharge for guidance in bringing the system up to pressure. The pump shall be attended constantly during the test by an authorized person. The pump shall be isolated from the system whenever the pump is to be left unattended.

9.4.3.6 Test pressure shall be checked by means of gauges having a range of 1.5 to 4 times the intended maximum test pressure. All gauges shall be calibrated against a standard dead weight tester and calibration records shall be provided to Westlake. It is preferable that the test pressure gauge be located 5’ above grade.

9.4.3.7 The piping test pressure is to be maintained for at least 10 minutes prior to starting inspection, and long enough to permit complete inspection of the system under test.

9.4.3.8 When conditions require that a pressure test be maintained for a period of time during which the testing medium in the system would be subject to thermal expansion, provision shall be made for relief of the excess pressure.

9.4.3.9 During hydrostatic testing, care must be exercised to limit the applied pressure to the particular portion of the system designated for the specified test pressure.

9.4.3.10 Care must be taken to avoid overloading any parts of supporting structures.

9.4.3.11 Vents or other connections shall be opened to eliminate air from lines which are to receive a hydrostatic test. Lines shall be thoroughly purged of air before hydrostatic test pressure is applied. Vents shall be open when systems are drained.

9.4.3.12 In cases where a pipe line being tested extends beyond the battery limit without flanges, it shall be tested to the first block valve or set of flanges outside the unit limit.

9.4.3.13 Short pieces of piping which must be removed to permit installation of blind flanges or blanks shall be tested separately.

9.4.3.14 Underground lines shall be tested before backfilling. Sewer and drain lines do not require pressure testing but shall be filled with water and allowed to stand for 24 hours and results noted on the test record.

9.4.3.15 Retesting of lines after repair of leaks shall be done at pressures originally specified for the test.

9.4.3.16 If piping is tested pneumatically, the test pressure shall be 110% of the design pressure. Any pneumatic test shall include a preliminary check at not more than 25 psig. The pressure shall be increased gradually in steps, allowing sufficient time for the piping to equalize strains during test. All joints welded, flanged or screwed shall be swabbed with a solution of 50% by volume of water and dish washing detergent during these tests, for detection of leakage. This includes air lines that are commodity tested. Refer to B31.3 Paragraph 345.5. Every effort should be made to avoid the practice of pneumatically.

9.4.4 Testing and Checkout

9.4.4.1 Pipe testing through equipment is to be avoided.

9.4.5 Pressure Testing with Instruments

9.4.5.1 Relief valves and rupture discs shall be removed, and the piping connections blinded or plugged prior to pressure testing. They shall not be reinstalled until flushing and testing are complete.

9.4.5.2 Orifice plates, flow nozzles or other similar restrictions shall not be installed in the piping system until flushing and testing have been completed.

9.4.5.3 Locally mounted indicating pressure gauges shall be removed and their connections plugged for testing. The gauges shall be installed following flushing and testing.

9.4.6 Completion of Testing

9.4.6.1 After the hydrostatic test has been completed, the pressure shall be released so as to not endanger personnel or damage equipment.

9.4.6.2 All vents at high point in the system shall be opened before the system is drained and shall remain open during draining to prevent pulling a vacuum on the system. All lines and systems shall be drained as completely as possible and blown down with air.

9.4.6.3 Systems that have been hydrostatically tested shall be drained in such a manner to provide the maximum amount of water flushing.

9.4.6.4 After completion of hydrostatic testing, all temporary blanks and blinds shall be removed and all lines completely drained. Valves, orifice plates, expansion joints, and short pieces of piping which have been removed shall be reinstalled with proper gaskets in place. After lines have been drained, temporary piping supports shall be removed, and insulation and painting completed. Test reports will not be approved until all temporary blanks are removed and a new gasketed joint is made-up satisfactorily, witnessed and signed off by a Westlake representative.

9.4.6.5 Testing is not complete until test records are completed and required copies given to Westlake.

9.4.7 Test Records

9.4.7.1 Accurate records shall be provided by the Contractor on each system tested. Each test may be witnessed by a representative of Westlake.

9.4.7.2 A copy of the Field Piping Pressure Test Report shall be retained by Westlake.

10 QA/QC PACKAGE REQUIREMENTS

10.1 The following items, if applicable, must be submitted to Westlake Geismar for any piping fabrication/installation.

10.1.1 Final Acceptance Sheet (Tied to Work Order # or Job #)

10.1.2 Work Order / Equipment / Line Number

10.1.3 Westlake Specification

10.1.4 WPS, PQR, and Welder Certs

10.1.5 Welder's Continuity Log

10.1.6 Weld Log (if there are a considerable number of welds, showing BW, SW, and Quantity of each per welder)

10.1.7 Isometric, Weld Mapping, and Flange Mapping

10.1.8 NDE Reports and NDE Certifications

10.1.9 Pre-Hydrostatic Test Checklist

10.1.10 Hydrostatic Test Report and Gauge Certifications

10.1.11 Post-Hydrostatic Test Checklist

10.1.12 Torque Sheets and Torque Wrench Certifications

10.1.13 P&IDs (marked to show work)

10.1.14 MTR'S for all material (not needed if received from Westlake warehouse and was already checked by Westlake Mechanical Integrity)

11 SERVICE INDEX

11.1 The Piping Specification Index shall be used as a guide in selection of the proper pipe specification. Pressure and temperature of the line under consideration must be within the ratings of the pipe specifications.

11.2 Selection of a piping specification based on service must be approved by Westlake Engineering.

11.3 Information given in piping specifications may not provide complete guidance on every scenario. In instances where additional information is needed, contact Westlake Engineering.

Chlor-Alkali Piping Specification Index

Spec	Description
A	CL 150, Carbon Steel, Welded, Flanged
AA	CL 150, Carbon Steel, Threaded & Welded, Flanged
AAFW	CL 150, Carbon Steel, Threaded & Welded, Flanged / HDPE
AB	CL 125, Galvanized Carbon Steel, Threaded & Welded, Flanged
AC	CL 150, Carbon Steel, Welded (Dry Cl2 Gas Service)
ACM	CL 150, Carbon Steel, Welded (Dry Cl2 Gas Service)
AF	CL 150, 304L Stainless Steel, Welded & Flanged
AFU	CL 150, 304L Stainless Steel, Welded & Flanged
AH	CL 150, 316L Stainless Steel, Welded & Flanged
AHB	CL 150, 2507 Super Duplex, Welded & Flanged
AHD	CL 150, Duplex Stainless Steel 2205 Buttweld & Threaded
AI	HDPE
APT	Tubing, PTFE or PFA
AQ	CL 150, PTFE Lined Carbon Steel
AS	CL 150, Nickel, Threaded & Flanged
AT	PVC, Solvent Welded & Flanged
ATA	CPVC, Solvent Welded & Flanged
ATK	Kynar
AV	CL 150, Titanium Gr 12 Welded & Seamless
AW	CL 150, Durcor® PTFE-lined Composite
AXA	CL 150, Fiberglass Reinforced Vinyl Ester
AXC	CL 150, FEP/FRP Dual Laminate Pipe
AXD	CL 150, Titanium Gr 2 Welded & Seamless
AXE	FRP NBS PS 15-69 (HETRON 197)
AXF	CL 150, Carbon Steel Buttweld (Sulfuric Acid >93%)
AXG	CL 150, PPE/FRP Dual Laminate Pipe
AZ	CL 150, Titanium (Reference Only – Use AXD)
B	CL 300, Carbon Steel, Welded & Flanged
BA	CL 300, 304L Stainless Steel
BCM	CL 300, Carbon Steel, Welded & Flanged (CL2 Gas Service) (Reference Only – Use CLBJ)
BCT	Tubing, Monel
BH	CL 300, 316L Stainless Steel, Welded Sch 40
BHA	Tubing, 316 Stainless Steel
BHT	Tubing, Hastelloy C-276
BS	CL 300, Nickel 200, Welded Sch 40
BT	CL 300G, Nickel 200, Welded Sch 10 (Reference Only – Use BS)
BXH	CL 300, Low-Temp Service Carbon Steel, Buttweld
CLBJ	CL 300, Carbon Steel, Welded & Flanged
D	CL 600, Carbon Steel, Welded & Flanged

VCM Piping Specification Index

Spec	Description
A	150 PSIG, Carbon Steel, Welded & Flanged
AA	150 PSIG, Carbon Steel, Welded & Flanged
AAFW	150 PSIG, Carbon Steel/HDPE, Welded & Flanged (Firewater)
AAO	150 PSIG, Carbon Steel, Welded & Flanged (Oxygen)
AB	150 PSIG, Carbon Steel, Galvanized, Welded & Flanged
ABC	150 PSIG, Carbon Steel, Welded & Flanged
AC	150 PSIG, Carbon Steel, Low-Temp, Welded & Flanged
ACM	150 PSIG, Carbon Steel, Welded & Flanged
AD	150 PSIG, Carbon Steel, Welded & Flanged
AF	150 PSIG, 304L Stainless Steel, Welded & Flanged
AFU	150 PSIG, 304L Stainless Steel, Welded & Flanged
AH	150 PSIG, 316L Stainless Steel, Welded & Flanged
AHD	150 PSIG, 2205 Duplex Stainless Steel, Welded and Flanged
AI	150 PSIG, HDPE, Welded & Flanged
AJ	150 PSIG, Carbon Steel & Cast Iron
APT	150 PSIG, PTFE Tubing, Swagelok
AQ	150 PSIG, Carbon Steel, PTFE Lined, Flanged
AR	150 PSIG, Monel, Welded & Flanged
ARA	150 PSIG, Inconel 600, Welded & Flanged
AS	150 PSIG, Nickel 200, Welded & Flanged
AT	150 PSIG, PVC, Flanged & Solvent Welded
AV	150 PSIG, Fiberglass Reinforced Plastic (Kynar), Flanged
AW	150 PSIG, Composite, PTFE Lined (Durcor), Flanged
AX	150 PSIG, Fiberglass Reinforced Vinyl Ester, Flanged
B	300 PSIG, Carbon Steel, Welded & Flanged
BB	300 PSIG, Carbon Steel, Welded & Flanged
BBC	300 PSIG, Carbon Steel, Welded & Flanged
BBO	300 PSIG, Carbon Steel, Welded & Flanged (Oxygen)
BCM	300 PSIG, Carbon Steel, Welded & Flanged (CL2 Service)
BCT	1500 PSIG, Monel Tubing, Swagelok
BD	300 PSIG, Carbon Steel, Welded & Flanged
BF	300 PSIG, 304L Stainless Steel, Welded & Flanged
BG	300 PSIG, 316 Stainless Steel, Welded & Flanged
BHA	300 PSIG, 316 Stainless Steel Tubing, Compression
BHT	1500 PSIG, Hastelloy C276 Tubing, Swagelok
BJ	300 PSIG, Low-Temp Carbon Steel, Welded & Flanged
BM	300 PSIG, 304L Stainless Steel, Cryogenic, Welded & Flanged
BR	300 PSIG, Monel, Welded & Flanged
D	600 PSIG, Carbon Steel, Welded & Flanged
EC	900 PSIG, 347H Stainless Steel, Welded & Flanged

PVC Piping Specification Index

Spec	Description
A	150 PSIG, Carbon Steel, Welded & Flanged
A1	150 PSIG, Carbon Steel, Welded & Flanged
AV	150 PSIG, Carbon Steel, Welded & Flanged
BA	150 PSIG, 304L Stainless Steel, Victaulic Coupling
BU	150 PSIG, Certa-Lok Yelowmine PVC, Victaulic Coupling
C	150 PSIG, 304L Stainless Steel, Welded & Flanged
C1	300 PSIG, 304L Stainless Steel, Welded & Flanged
C2	2500 PSIG, 304 Stainless Steel, Welded & Flanged
CV	150 PSIG, 304L Stainless Steel, Welded & Flanged
D	150 PSIG, 2205 Duplex Stainless Steel, Welded and Flanged
E	150 PSIG, Carbon Steel, Welded & Flanged & Threaded
F	Cast Iron, Hub & Spigot
F1	125 PSIG, Cast Iron & Galvanized Carbon Steel, Threaded
F2	150 PSIG, PVC, Solvent Welded & Flanged
G	150 PSIG, Carbon Steel, Welded & Flanged
H	300 PSIG, Carbon Steel, Welded & Flanged
H1	1500 PSIG, Carbon Steel, Welded & Flanged
K	150 PSIG, 304L Stainless Steel, Welded & Flanged
K1	150 PSIG, 304L Stainless Steel, Welded & Flanged
L	150 PSIG, Ductile Iron & PVC
N	150 PSIG, Copper & Galvanized Carbon Steel, Soldered & Threaded
P	150 PSIG, Galvanized Carbon Steel, Threaded
Q	300 PSIG, 304 Stainless Steel Tubing, Compression
Q1	300 PSIG, 304 Stainless Steel Tubing, Compression
R	150 PSIG, 304L Stainless Steel, Welded & Flanged
R1	304L Stainless Steel Duct
R2	Galvanized Carbon Steel Duct
T	150 PSIG, 304L Stainless Steel, Welded & Flanged
T1	150 PSIG, 304L Stainless Steel, Welded & Flanged & Threaded
U	150 PSIG, Carbon Steel Coated and Wrapped, Welded & Flanged
V	150 PSIG, 316L Stainless Steel, Welded & Flanged
V1	150 PSIG, 316L Stainless Steel, Welded & Flanged
Yb	150 PSIG, Carbon Steel PPL Lined, Flanged
Yd	150 PSIG, Carbon Steel Teflon Lined, Flanged