

TRANSNET PIPELINES
SPECIFICATION FOR LINE PIPE
PL 401/D
MARCH 2015



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1 GENERAL

This specification prescribes supplemental requirements to API Specification 5L, PSL2 which shall be considered concurrently as the requirements for delivery of line pipe. Pipe is for non-sour service, as defined in NACE MR0175/ISO 15156-1:2001. Only high frequency current shall be used in welding pipe to this specification. Pipe may be subsequently coated with a process that requires surface blasting. Where noted in the Scope of Supply pipe may be used for induction bends.

1.1 Summary

1.1.1 Scope of Specification

This specification covers the manufacturing and supply of Line Pipe, inspection and testing of the pipe, together with the supply of procedure specification, and test reports as required by this specification and API Specification 5L.

1.1.2 Related Specifications

The following specifications describe related Supply:

None

1.1.3 Definitions

For the purpose of this specification the following definitions apply:

COMPANY: Transnet Limited

MANUFACTURER: Line Pipe Manufacturer

SUPPLIER: Line Pipe Vendor

1.2 References

The publications listed below form part of this specification. Each publication shall be the latest revision and addendum in effect at the time of issue of this specification unless noted otherwise. Except as modified by the requirements specified herein, work included in this specification shall conform to the applicable provisions of these publications.

1.2.1 API (American Petroleum Institute)

API 1104 Welding of Pipelines and Related Facilities

API 5L Specification for Line Pipe – 2007 44th edition (including amendments) or later

API 5L1 Recommended Practice for Railroad Transportation of Line Pipe

API 5L3 Conducting Drop-Weight Tear Tests on Line Pipe

API 5L8 Field Inspection of New Line Pipe

API 5LW Transportation of Line Pipe on Barges and Marine Vessels



API Q1 Specification for Quality Programs for the Petroleum, Petrochemical and Natural Gas Industry

1.2.2 ASNT (American Society for Non-destructive Testing)

ASNT CP 189 Qualification and Certification of Non-destructive Testing Personnel

1.2.3 NACE (NACE International)

NACE MR0175/ISO 15156-1:2001

Petroleum and natural gas industries – Materials for use in H₂S containing environments in oil and gas production – General principles for selection of cracking-resistant materials

1.2.4 ASTM (American Society for Testing and Material)

ASTM E92 Standard Test Method for Vickers Hardness of Metallic Materials

ASTM E384 Standard Test Method for Microindentation Hardness of Materials

1.3 Submittals

1.3.1 Records

Accompanying supply of the pipe shall be certification as listed in Section 9. This includes a Hydrostatic mill test report, Charpy impact test reports, drop weight tear test reports and certified mill test reports on all pipe supplied under this specification and shall be mailed to the COMPANY, per Section 9 below.

1.3.2 Quality Assurance and Quality Control Plan

MANUFACTURER shall submit all documentation as outlined in the purchase documentation.

2 LINE PIPE

2.1 General

The pipe shall be Electric Resistance Welded (ERW) manufactured in accordance with good industry practice and shall conform to the requirements of API Specification 5L with monogram. Pipe ends shall be plain ends (with standard bevel) as per API 5L.

2.2 Quality

All materials used in the manufacture of pipe shall be manufactured in accordance with good industry practice and shall conform with the requirements of API Specification 5L with monogram. Rolling of plate and skelp shall comply with the requirements for special processes in API Specification Q1, "Specification for Quality Programs."



2.3 Chemical Properties and Tests

- 2.3.1 MANUFACTURER shall furnish the COMPANY the proposed target chemistry for the steel to be used to produce the pipe on this order prior to the pipe manufacture. All pipe shall be manufactured from fully killed continuous cast steel.
- 2.3.2 The chemical composition of base metal and weld metal shall comply that listed in API 5L.
- 2.3.3 The carbon equivalent (calculated as illustrated below) based on the check analysis shall be agreed upon between the COMPANY and MANUFACTURER but shall not exceed 0.40%. A chemical analysis of elements in the formula below shall be furnished by the MANUFACTURER:

$$CE(IIW)\% = C\% + Mn\%/6 + (Cr \% + Mo\% + V\%)/5 + (Ni\% + Cu\%) /15$$

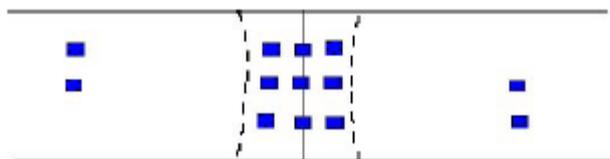
- 2.3.4 The MANUFACTURER shall furnish a ladle analysis and two check analyses from each heat of steel used in the production of pipe under this specification. Alloy additions of C, Mn, Cr, Mo, V, Ni, Cu, Si, Al, Ti, Nb, and B shall be reported, in addition to P and S, in these analyses. Non-expanded pipe shall comply with the chemical requirements for cold expanded pipe in API Specification 5L, as well as any more restrictive requirements in this specification.
- 2.3.5 The weld seam shall be fully normalized after the seam has been cooled to a temperature below 593 °C (1100 °F). Normalizing shall be above the transformation temperature Ac3 above 871° C (1600 °F) with necessary adjustments to achieve a normalized fine grain structure throughout the full wall thickness.
- 2.3.6 For those pipes indicated for bends, carbon shall be a minimum of 0.10%. MANUFACTURER shall pay strict attention to maintain the chemistry of the longitudinal weld material in order that the strength of the pipe is maintained through the cooling and quenching process of the bend fabrication.

2.4 Mechanical Properties and Tests

- 2.4.1 The MANUFACTURER shall conduct a weld tensile test (a set of two samples) on one length of pipe from each heat of steel used for the production of pipe under this specification with a minimum of one weld tensile test from each lot of 100 lengths of pipe produced. The ultimate tensile strength of the weld tensile sample shall meet the minimum tensile strength requirements for the body tensile specified in API Specification 5L for the appropriate pipe grade.
- 2.4.2 A yield strength restriction shall apply whereby 80% of the heats shall have a maximum yield strength of 103 MPa (15 KSI) over the SMYS, and the maximum yield strength of the remaining heats shall not exceed the SMYS by more than 138 MPa (20 KSI).



2.4.3 A micro-hardness survey, using Vickers hardness, of a cross-section from the weld seam shall be made from one length of pipe per 100 lengths produced. The maximum acceptable hardness shall be 248 Vickers hardness, using a 5kg weight tested to ASTM E92. The following drawing, which represents the pipe through wall including fusion line and HAZ, shows the locations for the hardness measurements: 6 readings in the HAZ, 3 readings at the fusion line, 4 readings in the pipe base metal.



2.4.4 The MANUFACTURER shall conduct Charpy impact tests in the body of the pipe in accordance with API Specification 5L SR5 at 0°C. The largest possible specimen size shall be used in accordance with Table SR5.1 (API Specification 5L). The shear area appearance of these tests must achieve 85% minimum average shear area for all heats, 65% minimum shear area for any single test (average of three samples). The minimum energy values (measured in the transverse direction) to be achieved in these Charpy tests for the respective pipe diameters are listed below.

NPS	Impact Toughness, Equivalent Full Size Specimen, (J)
All	The all-heat average of Charpy energy values shall meet of exceed the energy value calculated using the Battalle Columbus Laboratories formula BCL AGA in ASME B 31.8 Clause 841.11(c).(2) (a).

A set of three Charpy impact tests shall be conducted for each heat. Of the three tests, at least one shall be from a sample obtained from the end of a coil.

- 2.4.5 The MANUFACTURER shall conduct drop weight tear tests (DWTT) in accordance with API Specification 5L SR6 at 0°C. The shear area of the tests must achieve an 85% minimum average shear area for all heats, 65% minimum average shear area for any single test (average of two samples).
- 2.4.6 The MANUFACTURER shall conduct a set of three (3) transverse weld metal Charpy impact tests at 0°C twice per shift, in accordance with ASTM A-370. The tests must be from different heats. The notch shall be located at the fusion line. A minimum energy value of 34J is to be achieved in these Charpy tests.
- 2.4.7 Flattening tests shall be performed in accordance with API-5L with the following additional acceptance criteria. Flatten to 1/2 the original OD without the weld opening. Flatten further to 1/3 the original OD without cracks or breaks other than in the weld. Continue flattening until opposite walls of the pipe meet. No evidence of lamination or other defects may develop during the entire test.



3 MANUFACTURING AND FABRICATION REQUIREMENTS

- 3.1 For all purposes in this specification including inspection, the weld shall be defined as 6 mm on each side of the fusion line, and the heat affected zone (HAZ) shall extend a further 12 mm on each side of the weld area.
- 3.2 Cold expansion shall not be allowed.
- 3.3 No repairs by welding shall be permitted. All grinding repairs shall be performed in accordance with API 5L.
- 3.4 It is prohibited to make weld repairs to the coils used to manufacture pipe to this specification.
- 3.5 Arc burns shall be cut off (removed as a cylinder).
- 3.6 No dents of any depth located in the weld shall be accepted.
- 3.7 The use of jacks, or other mechanical methods, to reduce the size or remove any dents is prohibited.
- 3.8 Any surface defect that intersects the weld, at any point, shall be removed by grinding. This area shall then be inspected using magnetic particle inspection and the remaining wall thickness measured using ultrasonic inspection. The remaining pipe wall thickness shall remain within the supply tolerance.
- 3.9 Hard spots having hardnesses greater than HRC = 35 shall be removed as a cylinder.
- 3.10 At least one polished cross section of the weld seam shall be prepared per 100 lengths of pipe produced. An examination of this weld seam shall exhibit a fully normalized weld structure.

4 TESTING

4.1 Hydrostatic Testing

- 4.1.1 The hydrostatic test shall be as specified in API-5L, except as noted below.
- 4.1.2 The MANUFACTURER shall make available to the COMPANY the most recent certifications of calibration to the pressure gauges and recorders. This shall be provided with the bid, as well as immediately prior to the commencement of fabrication.
- 4.1.3 The minimum hydrostatic test pressure shall correspond to 95% of specified minimum yield strength. Each length of pipe shall be inspected for localized yielding after the hydrostatic test and any length of pipe with localized yielding shall be rejected.
- 4.1.4 The hydrostatic test is to be held for a minimum of 10 seconds.
- 4.1.5 The MANUFACTURER shall maintain a record of each joint being hydrostatically tested. The record shall indicate the joint number, test pressure and duration. A pressure test graph



shall be supplied for each length of pipe. This record shall be accessible upon request of the COMPANY representative.

4.2 Non-Destructive Testing

- 4.2.1 A copy of all non-destructive testing procedures shall be made available to the COMPANY prior to the start of production and at any time during the production, as required by the COMPANY or deemed appropriate by the MANUFACTURER.
- 4.2.2 All non-destructive testing required by API Specification 5L and this specification shall be performed by experienced and skilled personnel certified as Level II or III inspectors in accordance with ASNT's recommended practice SNT-TC-1A or equivalent approved international standard. MANUFACTURER shall make qualifications of personnel available to the COMPANY prior to start of production.
- 4.2.3 The MANUFACTURER shall provide a standard form for all non-destructive testing to the COMPANY representative at the end of each turn (eight-hour shift). This shall represent the number of joints tested per non-destructive testing method, including the joint number and discontinuities located, the disposition of each joint, and the initials of the individual conducting the test of each joint.
- 4.2.4 All non-destructive testing equipment shall be calibrated a minimum of two (2) times per turn (eight-hour shift) and after any extensive shutdown at the discretion of the COMPANY representative.
- 4.2.5 Ultrasonic inspection shall be performed 25 mm from the bevel on both ends of each length of pipe to examine for mid-wall laminations.
- 4.2.6 The weld seam shall be 100% ultrasonically tested after hydrostatic testing. The calibration standard for this seam inspection shall consist of O.D. and I.D. "N10" notches and 3.2 mm thru drilled holes. Holes shall be at least 25 cm apart, with one on the weld centreline and two offset 3.2 mm from the weld centerline on each side. The centre of the weld centreline hole shall be located within 9 mm from the end of the calibration standard.
- 4.2.7 Any signals during the UT seam weld inspection that exceed the above given calibration shall be considered rejectable defects.
- 4.2.8 The calibration of the ultrasonic inspection equipment shall be verified under dynamic conditions representative of normal production.



5 DIMENSIONS AND TOLERANCES

5.1 Electric Resistance Weld (ERW) pipe shall be furnished in the following lengths

The pipe shall be furnished in 40ft Nominal length (formerly double random lengths).

Maximum length 12,8m

Minimum length 6,0m

The lengths of 92% of each carload of pipes of any diameter and wall thickness to between 12,0m and 12,8m.

5.2 No jointers (two pieces of pipe welded together to make a standard length) shall be used.

5.3 Tolerances on dimensions and weights shall conform to the requirements of API 5L.

5.3.1 Pipe shall not deviate from a straight line by more than 0.13% [15.6 mm per 12 m length or 23.4 mm per 18 m length].

5.3.2 The outside diameter shall not be more than 2.3mm greater than the specified O.D., nor more than 0.79mm less than the specified O.D. as measured with a diameter tape. The outside diameter of pipe greater than or equal to 406mm O.D. shall be measured on the following frequency: Pipe ends - each joint, Pipe body - every 20 joints.

5.3.3 Each joint of pipe greater than or equal to NPS 16" O.D. shall be measured for out-of-roundness for 20 cm from the end of the pipe. The difference between the maximum and minimum diameter measurement shall not exceed 1% of the specified outside diameter. Ring gauges, bar gauges, callipers, or other devices capable of measuring the actual minimum and maximum diameters shall be used.

5.3.4 The use of jacks to achieve the above criteria is prohibited.

6 INSPECTION

6.1 Plant Inspection

At the discretion of the COMPANY, the manufacturing, testing, and loading of the pipe shall be inspected by the COMPANY's representative. All pipe that does not comply with this specification shall be rejected and replaced with pipe that does comply with this specification. MANUFACTURER shall supply general office facilities to support COMPANY's inspection.

6.2 Pipe Inspection

At the discretion of the COMPANY, independent inspection of the pipe may be performed by the COMPANY, or appointed representative, continuously or on an ad-hoc basis. All pipe that does not comply with this specification shall be rejected and replaced with pipe that does comply with this specification. MANUFACTURER shall supply general office facilities to support COMPANY's inspection.



6.3 Field Inspection

- 6.3.1 If a failure should occur during the field hydrostatic testing, the segment of pipe containing the failure shall be located, removed, and replaced. The segment of the pipe containing the origin of the failure shall be sent to a consultant for analysis.
- 6.3.2 The COMPANY shall notify the MANUFACTURER of the failure and shall give the MANUFACTURER sufficient notice of rescheduled commencement of field hydrostatic testing to permit the MANUFACTURER to have a representative present during the testing if the MANUFACTURER so desires.

7 IDENTIFICATION

7.1 Type and Location of Identification

- 7.1.1 Identification markings shall be stencilled with paint on the pipe. Die stamping shall not be used. Each pipe length is to be numbered individually.
- 7.1.2 The markings shall be located on both ends of each length of pipe; on the interior surface of the pipe, a minimum of 30 cm from the ends.
- 7.1.3 When specified in the Design Information, an exterior colour band is required on each end of the pipe to distinguish pipe size and wall thickness. The colour band shall be a minimum of 50 mm wide. Colours to be used for each pipe specification shall be as per the purchase specification.
- 7.1.4 Bar code identification – no clause.
- 7.1.5 The paint and bar-code system shall be suitable for the purpose and shall be weather durable and capable of being removed by normal pipe coating preparation methods without leaving deleterious residues.

7.2 Information Required

Identification markings shall be in accordance with API 5L, Appendix I, and shall include at least the following:

- MANUFACTURER's Name or Mark
- API Monogram
- Outside Diameter
- Wall Thickness
- Symbol Indicating Grade
- Product Specification Level
- Symbol Indicating Process of Manufacture



- Mill Test Pressure in English Units Preceded by "Tested"
- MANUFACTURER's Identification Markings for Quality Control Records including pipe number.
- API Toughness Test Requirements (if applicable)
- Pipe Purchase Order
- Length of Joint in metres to the nearest cm
- Symbol Indicating Heat Treatment
- Heat Identification Number
- Pipe number – number must correlate with the heat number
- The fusion line shall be marked on the interior surface on both ends of each length of pipe with an accuracy of ± 3 mm.

8 SHIPPING

8.1 Racking in MANUFACTURER's Yard

- 8.1.1 All equipment for handling bare pipe shall be free of contaminants that may adversely affect coatings. All equipment for handling coated pipe shall be adequately padded to prevent damage to the pipe and coating. Sling hooks shall be lined with a phenolic liner.
- 8.1.2 All pipe shall be segregated by size, wall thickness, and grade.
- 8.1.3 Each length of coated pipe shall be separated from each adjacent joint by not less than three 18 mm polypropylene rope collars per pipe joint, one near each end of the pipe and one in the middle. MANUFACTURER shall furnish polypropylene rope collars. Spacing of collars shall not exceed 6 meters.
- 8.1.4 The pipe shall be racked in tiers as shown in Attachment 02 Figure 2. The first tier of pipe shall be not less than 100 mm from the ground. The padding shall have COMPANY's approval prior to racking of the pipe.
- 8.1.5 Pipe shall not be racked more than:
- Eight tiers for NPS 16" pipe
 - Six tiers for NPS 18" pipe
 - Four tiers for NPS 24" pipe
- 8.1.6 The MANUFACTURER shall furnish all supervision, labour, materials, equipment, and services necessary for the racking of the pipe.



8.2 Loading of Pipe for Shipment

- 8.2.1 No pipe shall be shipped until the respective mechanical testing has been completed with acceptable results.
- 8.2.2 All equipment for handling pipe shall be adequately protected to prevent damage to the pipe. The padding must have the COMPANY's approval prior to loading of the pipe.
- Sling hooks shall be lined with a phenolic liner.
 - Pipe retainers, if used, must be padded, and tie-down apparatus will be nylon straps only.
 - Trailer wheels of conveyance must be fitted with gravel guards in condition as required by law to prevent gravel impact damage and the accumulation of mud and road oil on the pipe.
- 8.2.3 Flat bed trailers, onto which pipe is loaded, must be of the proper length to prevent overhang. Overhang is not permitted unless approved by the COMPANY, and in no case shall exceed 1.2 meters beyond the end of the trailer for bare pipe or 600 mm beyond the end of the trailer for coated pipe.
- Prior to loading NPS 24" diameter and smaller ERW pipe, four (4) bearing pieces are to be placed on the bed of the trailer. Each bearing piece consists of an 2.5 meter long piece of 10 cm x 10 cm (4" x 4") or 5 cm x 15 cm (2" x 6") hardwood lumber in good condition with an 20 cm long, 10 cm x 10 cm (4" x 4") or 15 cm x 15 cm (6" x 6") angle block nailed to each end at the appropriate location to accommodate the applicable pipe size, for pipe spacing and stability (See Attachment 01 Figure 1). Bearing pieces are to be oriented transverse to the pipe and spaced evenly beneath it.
 - Four separators are to be used between each row when pipe is not nested. Separators consist of 5 cm x 10 cm (2" x 4") or 5 cm x 15 cm (2" x 6") hardwood lumber in good condition with 10 cm x 10 cm (4" x 4") or 15 cm x 15 cm (6" x 6") angle blocks nailed on top and bottom at each end for pipe spacing and stability (See Attachment 01 Figure 1).
 - Each length of pipe shall be separated from each adjacent length by not less than three 18 mm (3/4") polypropylene rope collars, one near each end and one in the middle. In the case of triple random length pipe, a minimum of 5 polypropylene rope collars will be required, spaced evenly along each joint. Collar spacing shall not exceed 6 meters (20 feet).
 - All pipe is to be loaded in layers with a minimum of two (2) 100 mm nylon straps or four (4) 50 mm nylon straps per layer, and with a minimum of three (3) 100 mm nylon straps or five (5) 50 mm nylon straps wrapped over the top layer encompassing the entire load (See Attachment 03 Figure 3).
- 8.2.4 Pipe will be loaded in layers and will not be nested in pyramid fashion unless specifically authorized by the COMPANY (See Attachment 03 Figure 3)
- Pyramiding of pipe, while an acceptable industry standard, is not recommended by the COMPANY. Layer loading provides a much more stable loading condition and is therefore the COMPANY standard.



- Pyramiding of pipe is acceptable in certain conditions, such as the following:
- The transport of bare pipe over short distances.
- The transport of coated pipe between rail sidings and job site locations.
- The transportation of coated pipe between a pipe coater's location and a rail loading site.
- In all cases, coated pipe being loaded in pyramid fashion must be fully protected from contact with adjacent pipe joints through the use of the required number of polypropylene rope collars and secured properly to the transporting conveyance.

8.2.5 The transportation by rail of both coated and bare pipe shall in all cases comply with API Recommended Practice, RP 5L1, "Recommended Practice for Railroad Transportation of Line Pipe."

8.2.6 The SUPPLIER, at the end of each day, shall provide a tally of each conveyance loaded certifying the number of joints loaded, total length, and weight per conveyance.

9 RECORDS

9.1 All pipe issued under this specification shall have the three (3) hardcopies of the certification, and one electronic copy, mailed to the COMPANY containing the following:

- Hydrostatic mill test report
- All Charpy impact test reports
- All drop weight tear test reports
- Certified mill test reports, indicating API spec 5L with monogram
- Compliance with SR-15 of API Specification 5L – 2004 43rd edition is required

9.2 Each report shall be identified by purchase order number, MANUFACTURER's name, pipe size, yield strength and heat number

9.3 Reports shall be mailed within ten (10) days after completion of rolling as specified in the Purchase Order.

9.4 All MANUFACTURER's records of pipe disposition shall be included with the COMPANY records described above.

ATTACHMENTS

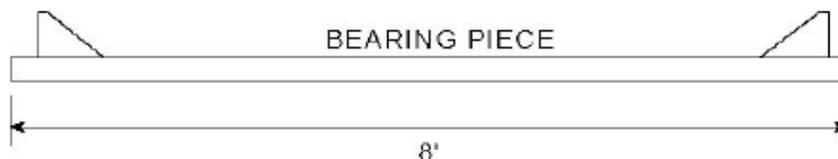
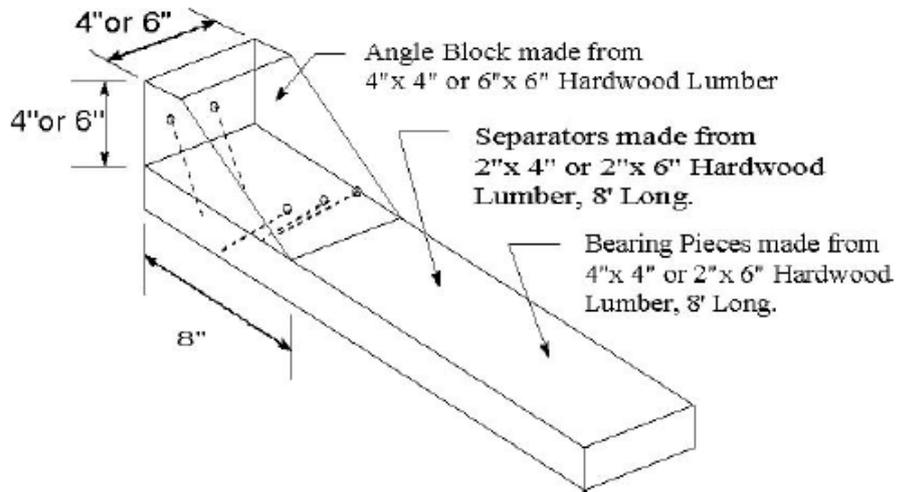
Attachment 01: Figure 1

Attachment 02: Figure 2

Attachment 03: Figure 3

FIGURE 1 BEARING PIECE AND SEPARATOR DETAIL

NOTE: 4" = 10cm, 6"=15cm, 8"=20cm



Bearing Pieces have an angle block nailed near each end, located based on pipe diameter, for pipe spacing and stability.



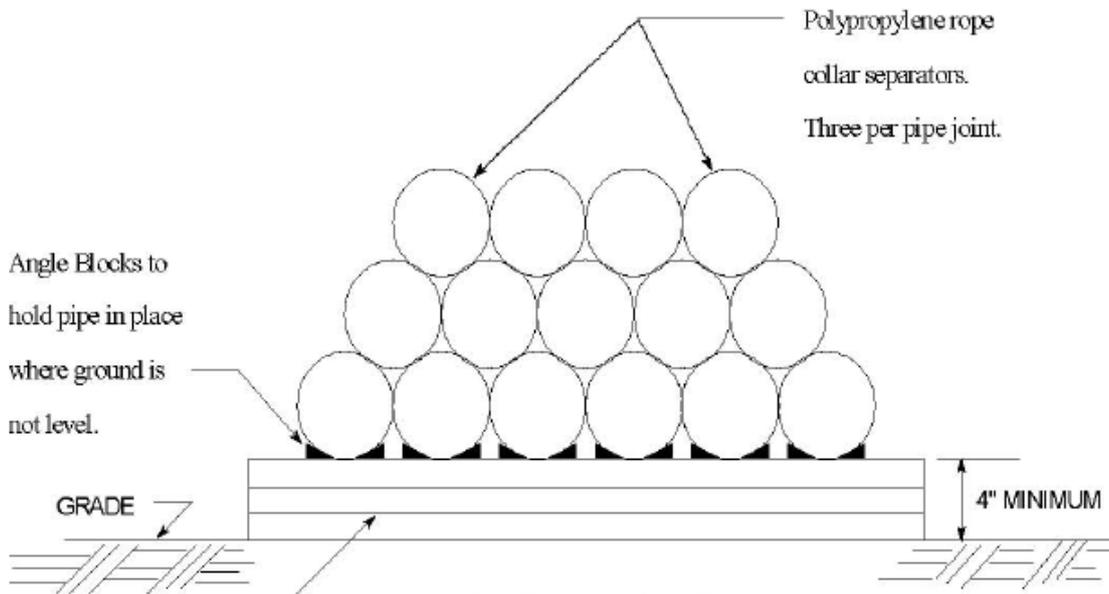
Separators have an angle block nailed on top and bottom near each end, located based on pipe diameter, for pipe spacing and stability.

GENERAL RULES

- Hardwood is to be used for all bearing pieces, horizontal separators, and angle blocks.
- Lumber showing decay, excessive splitting or checking, excessive warping or large, strength impairing knots is not to be used.
- Angle blocks are to be a full 20 cm (8") long as shown above and shall match and be aligned with the width of the lumber used for bearing pieces or separators.
- Three (3) 16d nails are to be used on the tapered face and two (2) 16d nails are to be used on the vertical outside face.

FIGURE 2 PIPE RACKING REQUIREMENTS

NOTE: 4" = 10cm, 6"=15cm, 8"=20cm

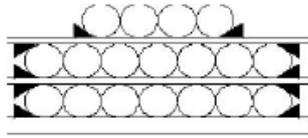


Runners consist of 5cm x 15cm (2"x 6") hardwood lumber, stacked vertically. Five (5) runners are required, oriented transverse to the pipe and spaced evenly under it.

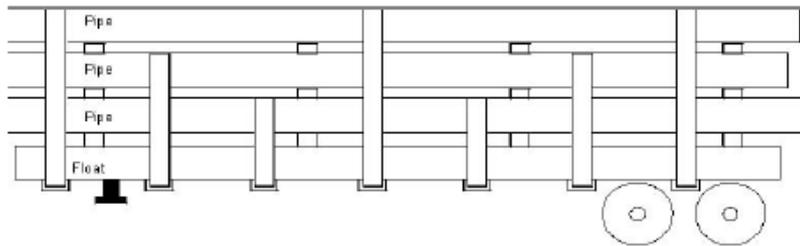
MAXIMUM RACKING HEIGHTS

Pipe Diameter	Maximum Number of Tiers
NPS 16"	8
NPS18:"	6
NPS 24"	4

FIGURE 3 PIPE LOAD-OUT AND TIE-DOWN REQUIREMENTS



Nesting is not permitted for pipe less than NPS 36" in diameter without specific COMPANY approval. The number of joints on the top layer is limited based on weight restrictions.



The tie-down configuration shown is for straps with a minimum width of 10cm (4"). A minimum of two straps are required per layer of pipe, with three straps over the top layer encompassing the entire load.

NOTE: See Section 8.2.3 for requirements when using 5cm (2") wide straps