Code of Practice

Upstream Polyethylene Gathering Networks - CSG Industry

Companion Paper CP-03-002

Guidelines for Acceptance Criteria of Surface Discontinuities

Rev 0

June 2025

Important note on use of the *APGA Code of Practice for Upstream Polyethylene Gathering Networks in the Coal Seam Gas Industry*.

This Code of Practice has been developed for the use of organisations involved in the CSG industry, primarily in Australia and New Zealand.

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Scope

The scope of this Companion Paper is related to the provision of guidelines for accepting surface discontinuities found on the surface of HDPE pipe used for gas and water gathering systems. The discontinuities commonly encountered are:

- Surface defects resulting from pipe extrusion
- Mechanical damage from storage, transportation, offloading and stringing.

This Paper provides guidance as to what discontinuities are acceptable or not will ensure that rectification work is not performed unnecessarily.

1. Background

The amount of pipe required for off-plot gathering has increased significantly over the last year, and coupled with this, more surface discontinuities have been found on the pipe during installation.

The Australian standards give limited information about what surface defects are acceptable or not; the standards applicable to the off-plot work are:

- PE pipe Manufacture: AS/NZS 4130 – *PE pipe for pressure applications*
- Installation: AS/NZS 2033 – *Installation of polyethylene pipe systems*
- Guidance: The Code of Practice

The wording given in section 9.5.1 of AS/NZS 4130 for manufactured pipe is:

Defects shall not affect the performance or function of the pipe in service. Pipes shall not have blisters, voids, burnt particles, heat marks or delamination of stripes or jackets. When grooves, wrinkles, rippling or dents or projections are present, the pipe shall conform to the dimensional requirements of Table 2 and 3 as appropriate. Where defects are present, and the product is submitted for acceptance, the manufacturer shall be able to demonstrate its conformance to this standard.

This clause indicates that the following defects are not acceptable:

- Blisters
- Voids
- Burnt particles
- Heat marks
- Delamination

And, for the acceptance of grooves, wrinkles, rippling dents or projections, acceptance will depend on the dimensional requirement given in Tables 2 and 3 of AS/NZS 4130.

For comparison, a review of international standards for PE piping such as API, BS, EN and GIS gives similar guidance.

Section 3.3.3 of installation standard, AS/NZS 2033, gives clear instructions for what pipe damage is acceptable:

Prior to installation. The allowable damage to the external surface shall be up to 10% of the wall thickness. Kinks in pipe shall not be installed, re-rounded or repaired by reheating…. pipe may be cut to remove damaged sections, and the remaining sections may be used.

2. Morphology of discontinuities observed during installation

The typical discontinuities observed to date are shown in the following sections of this Companion Paper:

Section 4 — Pipe Manufacturing Defects

Section 5 — Typical Mechanical Damage

Note: Sections 4 and 5 do not show all the possible discontinuities, and this document will be updated as other discontinuity types are observed.

3. Acceptance criteria

Table 1 summarises the acceptance criteria for visual inspection of the external surface of the HDPE pipe.

The classification of discontinuities is not always clear cut, this is particularly true for what constitutes a gouge and what is a crack; for the purposes of this document the following descriptions apply:

Gouge — this is a linear discontinuity where significant deformation of the material has taken place, (for example see Figure 5.1).

Scratch — a linear discontinuity where there is minor or no deformation.

To facilitate the decision whether a discontinuity is a scratch or a gouge, consider Figure 1. If the height of the bead is minor or non-existent, the discontinuity can be regarded as a scratch. If the bead indicates significant deformation, then the defect can be regarded as a gouge. The width of a gouge will also be wider than a scratch, (for example see Figure 5.2).

Note: The evaluation and acceptance of a gouge or a scratch is subjective, if doubt exists, the pipe section should be quarantined for further evaluation.

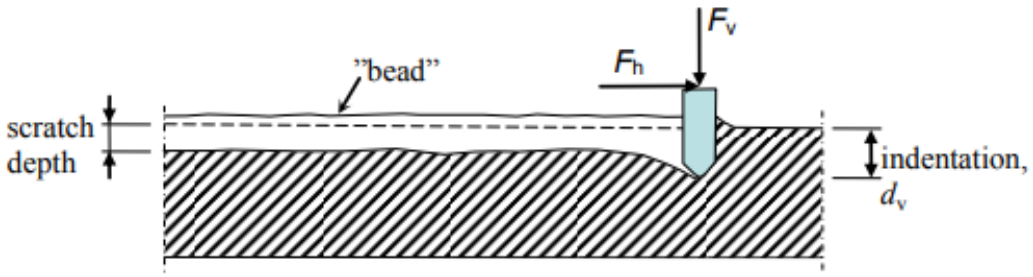

Figure 1 — Morphology of a scratch or gouge in HDPE pipe

Table 1 – Acceptance criteria

		Distinguishing characterisics	Acceptable depth	Acceptable length or area	Examples
Pipe manufacture	Blisters		Not acceptable		
	Voids				
	Burnt particles				
	Heat marks				
	Delamination				
	Scabs (isolated surface roughness)	Flakes with a shallow appearance almost flush with the suface of the pipe with little depth around the edges. **Note:** Where doubt exists regarding this classification, the defect shall be evaluated using the SURFACE INCLUSIONS acceptance criteria	10% of wall thickness, max	35mm x 35mm max.	Figures 4-1, 4-2 and 4-3
	Resin inclusions	The resin inclusion have the shape of a one or more resin pellets pressed into and bonded with the pipe material. Easy to distinguish since the resin inclusions are only seen for the resin	10% of wall thickness, max	20mm x 20mm max.	Figures 4-4, 4-5, 4-6

		Distinguishing characterisics	Acceptable depth	Acceptable length or area	Examples
		used for adding the coloured stripe.			
	General pipe surface roughness (watermarks)	A very shallow wavy pattern covering almost the entire external surface of the pipe	Pipe showing these watermarks are acceptable provided that the depth of the marks are insignificant, that is of the order <0.5mm		Figures 4-7 and 4-8
	Surface inclusions	Seen as lumps of extruded pipe material that has been pressed into the surface of the pipe. This is due to material adhering to the die and being forced into the pipe surface during vacuum sizing.	10% of wall thickness max	20mm x 20mm max	Figure 4-9, 4-10 and 4-11
Mechanical damage	Gouges		10% of wall thickness max	Area: 50mm x 50mm max. Max. length 300 mm	Figures 5-1, 5-2, 5-3 and 5-4

		Distinguishing characterisics	Acceptable depth	Acceptable length or area	Examples
	Scratches		10% of wall thickness max (Note 1)	Any scratch with a depth greater than or equal to 8% and less than 10% shall be limited to a length of 1/3 the length of the pipe Scratches less than 8% of the wall thickness are acceptable with no limit on the length. (see Note 2)	Figure 5-2
	Inclusions (e.g. Stones)		10% of wall thickness max after removal of inclusion	Area: 20mmx20mm max	Figure 5-5
	Transportation damage due to ratchet straps	This damage is due the metal ratchet mechanism making direct contact with the pipe surface during transportation.	10% of wall thickness max	Area: 50mmx50mm max. Max length 300mm	Figure 5-6
	Damaged pipe ends (any discontinuity)	Not acceptable (unless the defect can be removed during facing)			Figure 5-7 and 5-8

Note 1. The shape of the groove can be either U or V-shaped. The acceptance criteria for scratches are based on the recommendations given by the SP Technical Research Institute of Sweden

Note 2. As an example, for the acceptance of scratches:

- Case 1: scratch depth 12% of wall thickness and 150mm long = reject
- Case 2: scratch depth 8.5% of WT= acceptable provided the length is less than 1/3 the length of the pipe.
- Case 3: scratch is 5% of wall thickness = acceptable, no limit of the length, i.e. can be the full length of the pipe.

Bergstrom, G., et.at. (2009), Acceptance criteria for scratches and indications in plastic pipe, SP Report 2009:21E, SP Technical Research Institute of Sweden.

4. Typical Manufacturing Defects

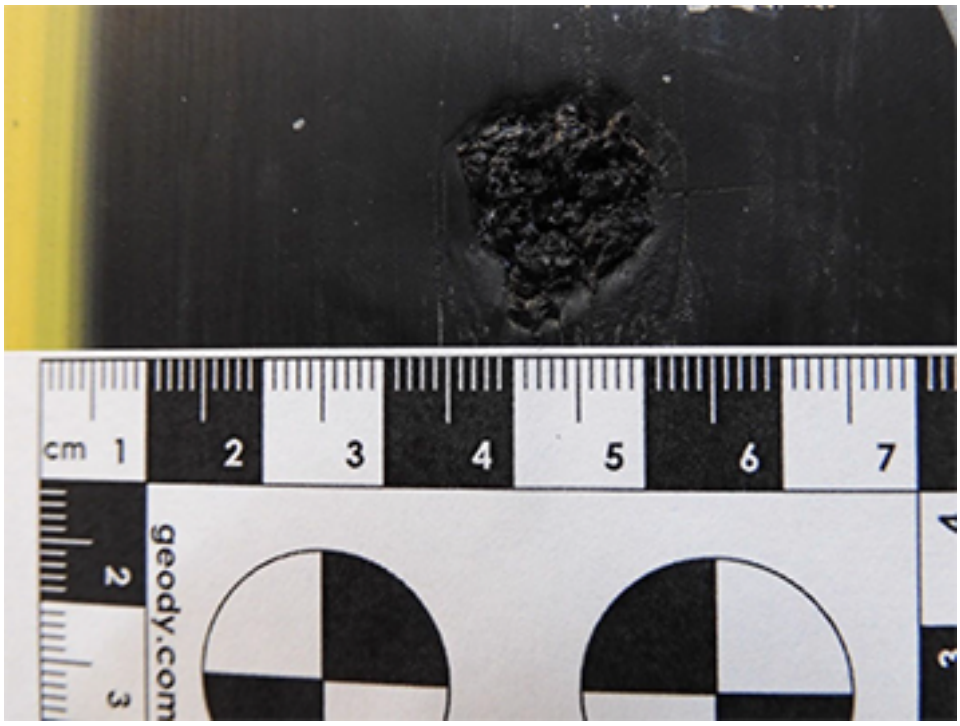

Figure 4-1 — showing a scab consisting of fine folds or flakes of extruded HDPE resulting in a roughened surface

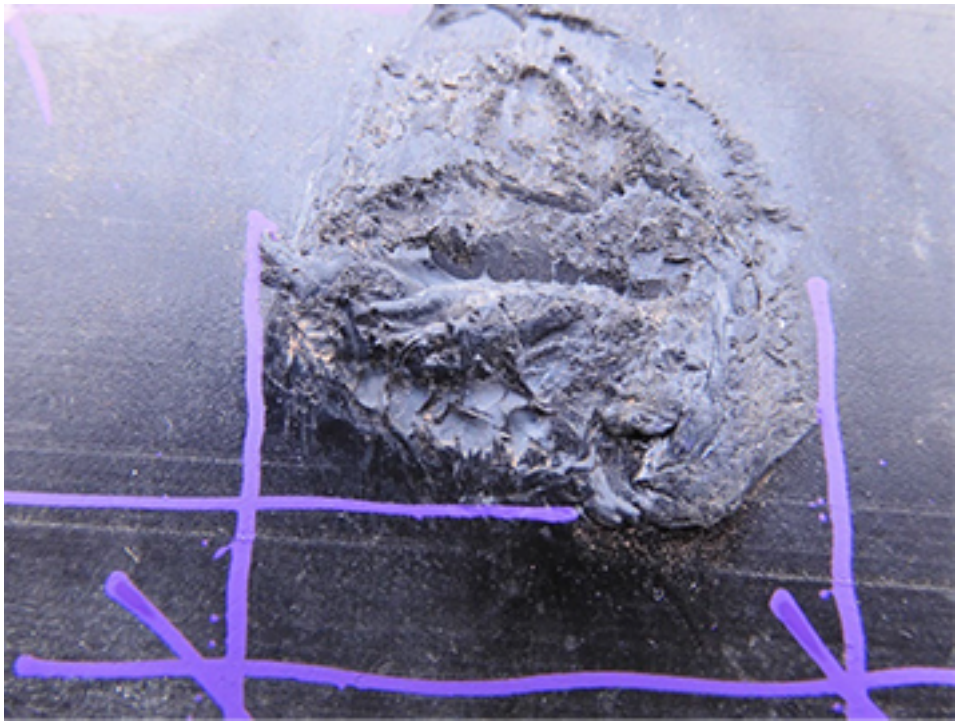

Figure 4-2 — showing a scab consisting of fine folds or flakes of extruded HDPE resulting in a roughened surface

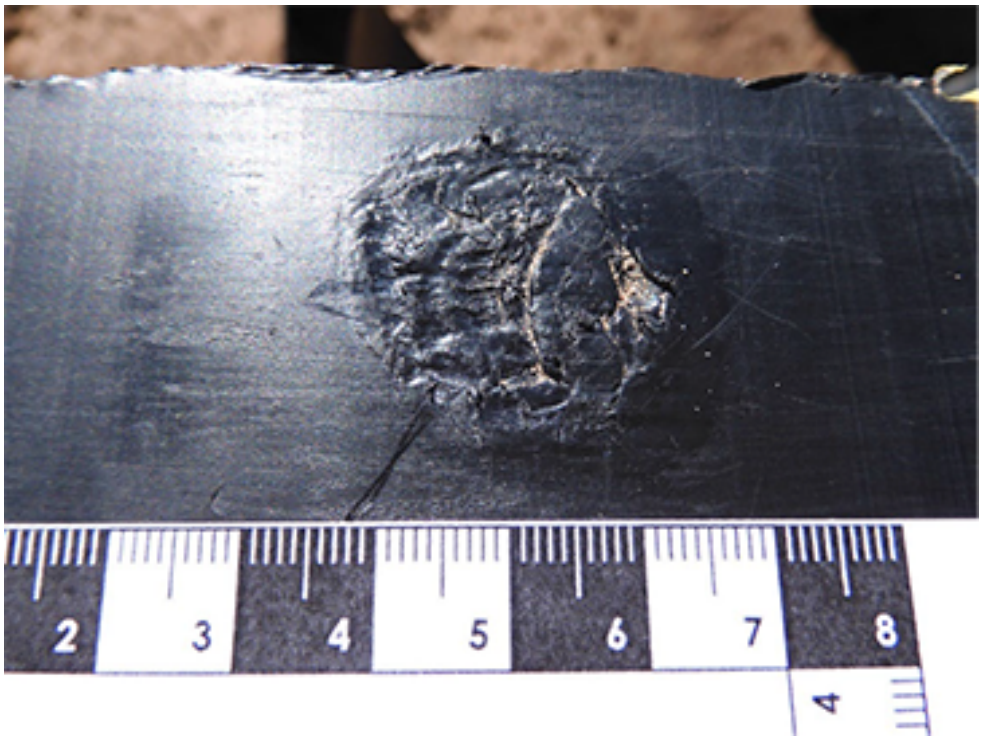

Figure 4-3 — Scab — notice scabs have little depth around the edge

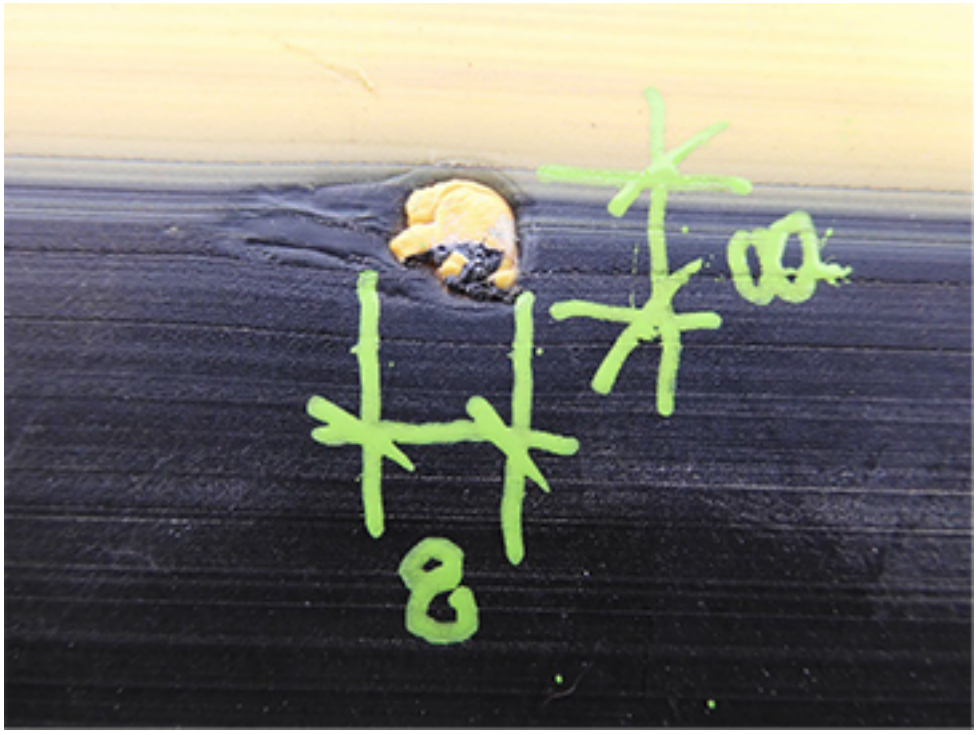

Figure 4-4 — Resin inclusion

Figure 4-5 — Resin inclusion

Figure 4-6 — Resin inclusion

Figure 4-7 — Shallow surface ripples," watermarks" typically covering a large percentage of the pipe surface

Figure 4-8 — Watermarks

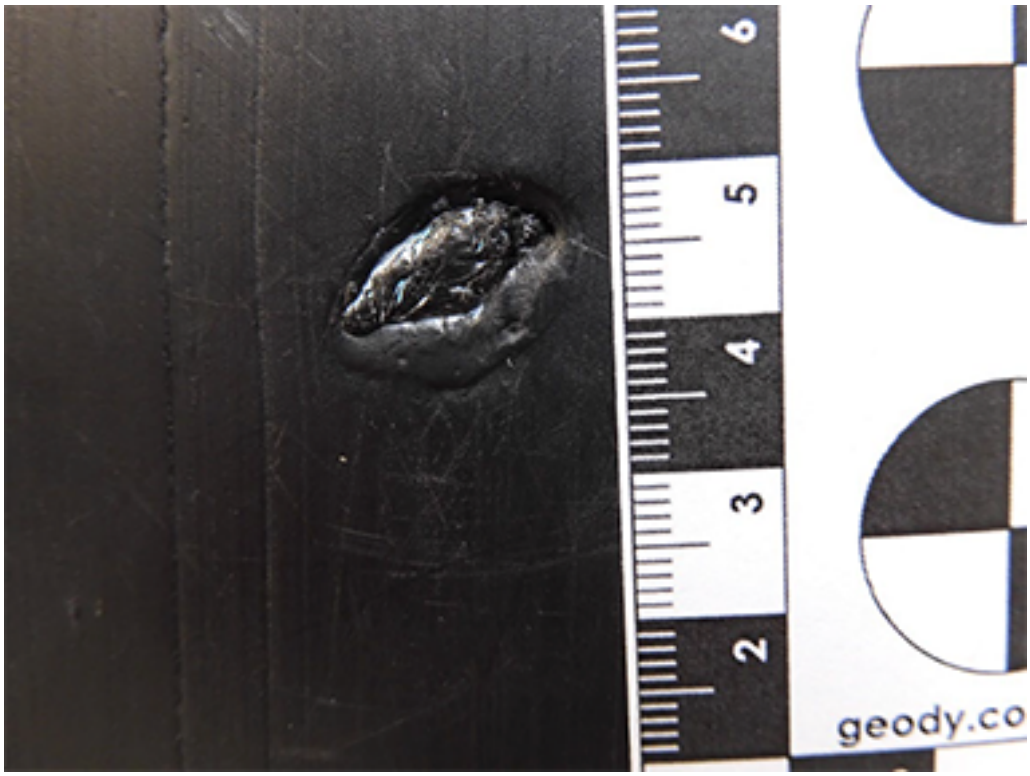

Figure 4-9 — Surface inclusion — loose extruded resin “pressed” into the pipe surface

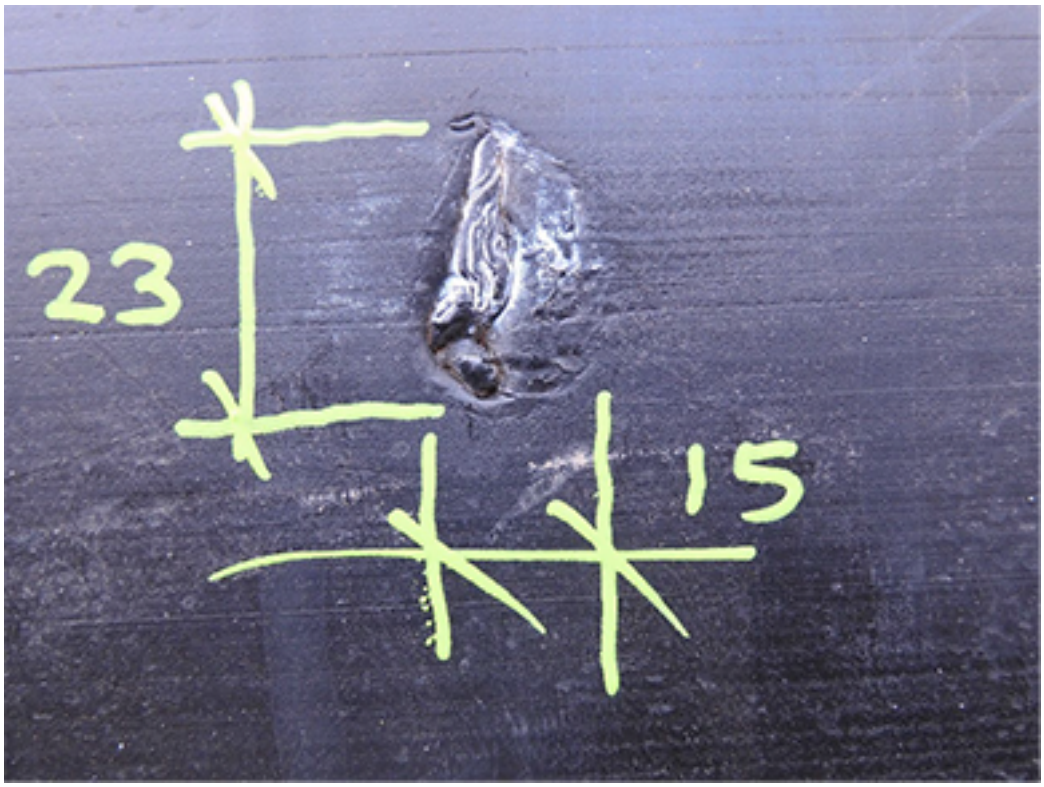

Figure 4-10 — Surface inclusion

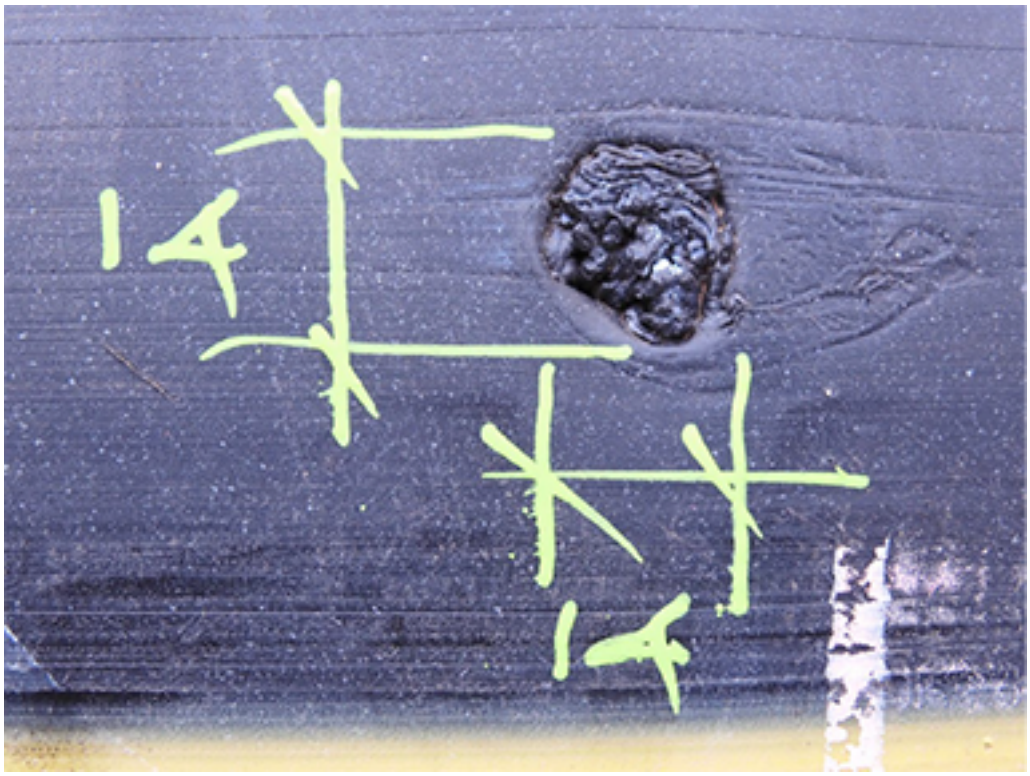

Figure 4-11 — Surface inclusion. Loose extruded resin being “pressed” into the surface

5. Typical Mechanical Damage

Figure 5-1 — Gouge

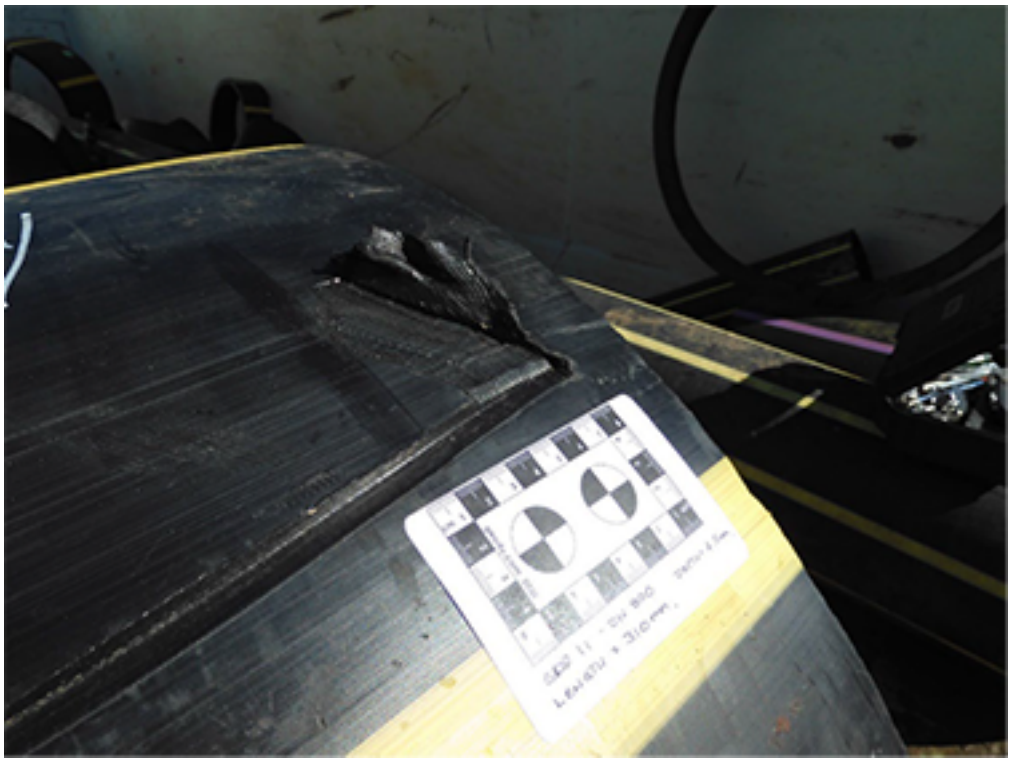

Figure 5-2 — Surface scratch and gouge, this damage is also located at the end of a pipe

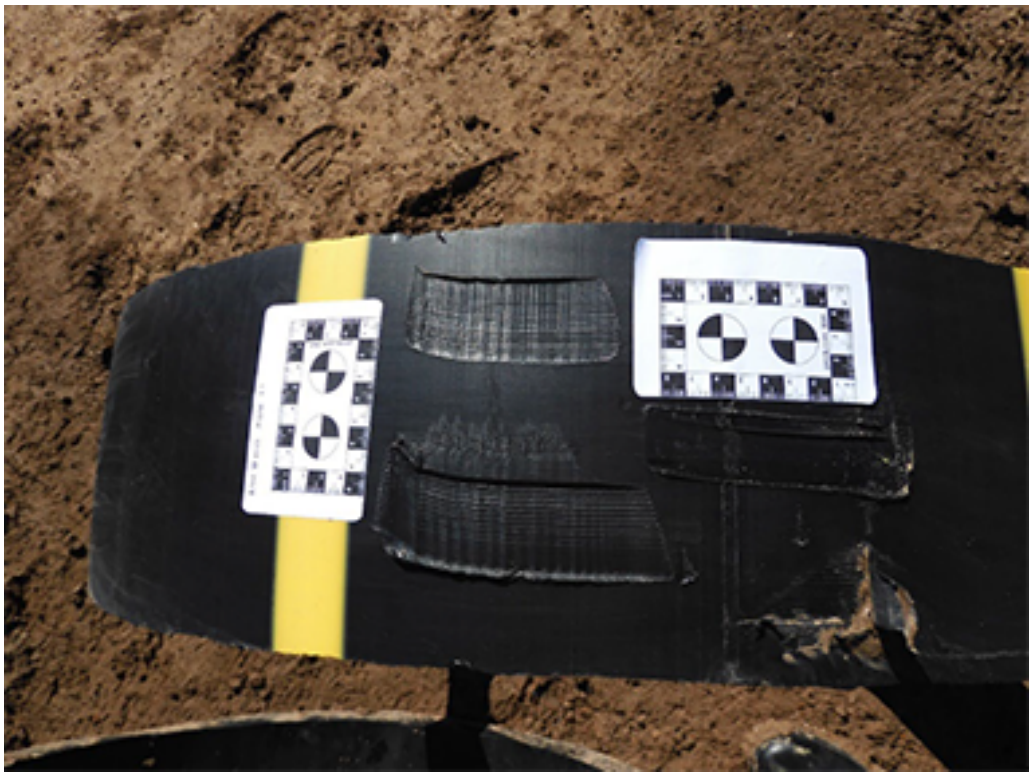

Figure 5-3 — Gouge

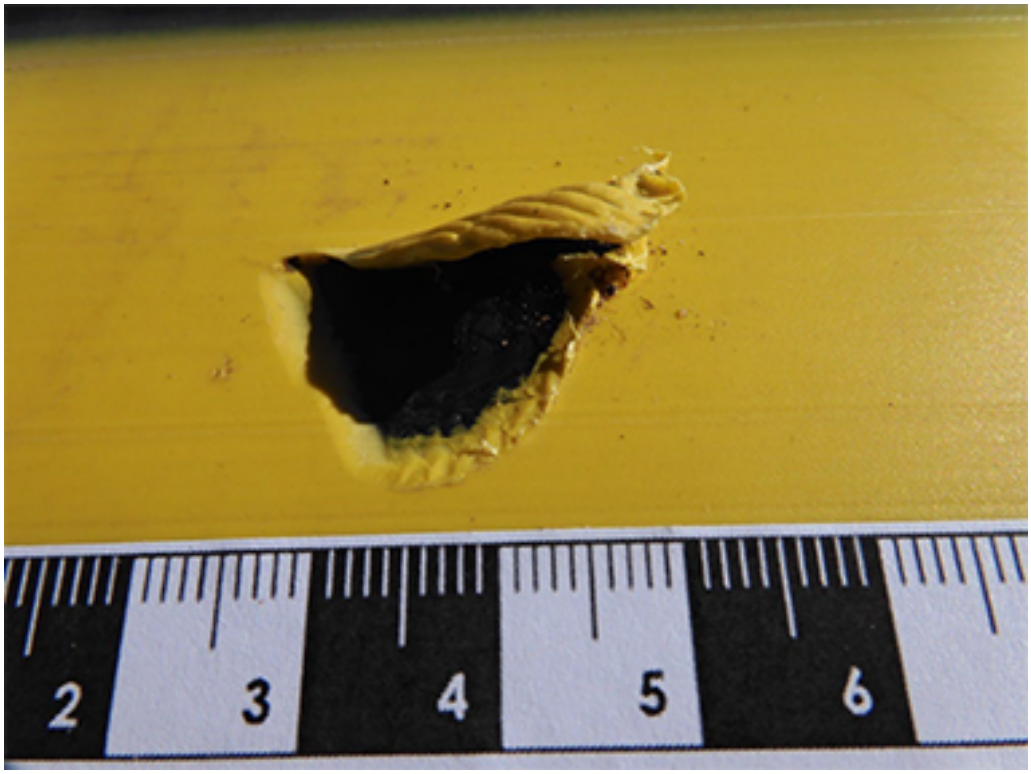

Figure 5-4 — Gouge

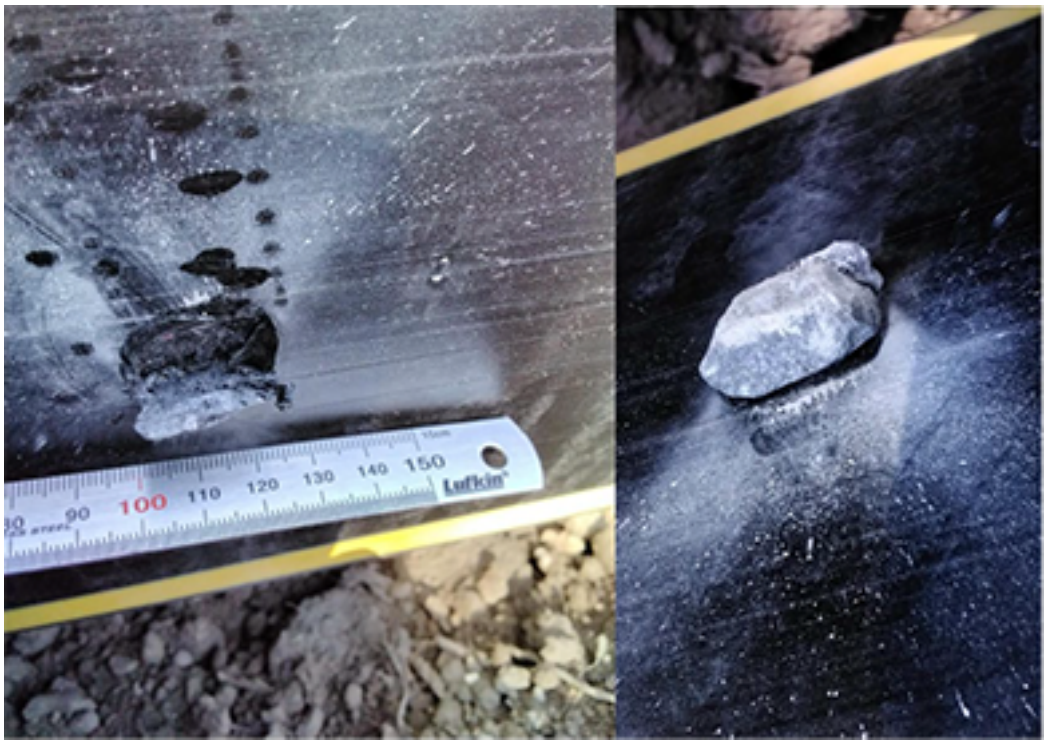

Figure 5-5 — Surface inclusions (stones in this case)

Figure 5-6 — Transport damage from ratchet straps

Figure 5-7 — Gouge at pipe end

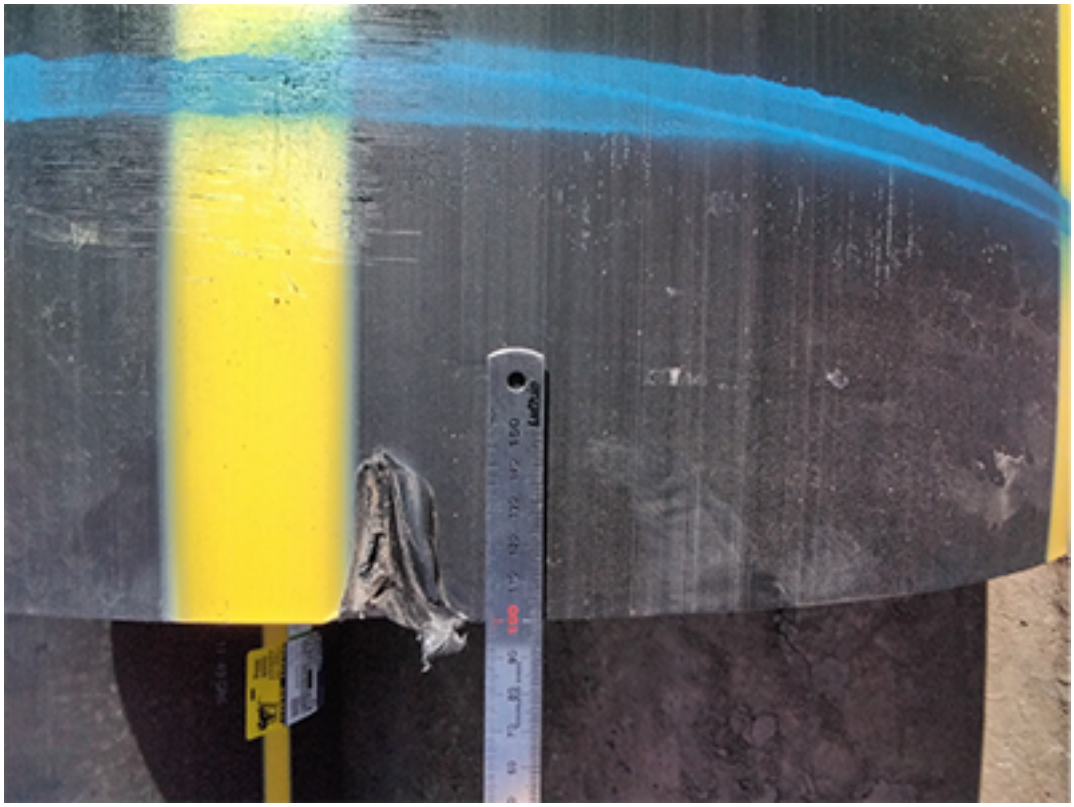

Figure 5-8 — Gouge at pipe end