Plastics Industry Pipe Association of Australia Limited
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Industry Guidelines

IDENTIFICATION OF BURIED PIPE SYSTEMS

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Pipelines Integrity For a Cleaner Environment

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IDENTIFICATION OF BURIED PIPE SYSTEMS

Infrastructure pipeline networks are usually buried and therefore not visible without excavation. When they are exposed by excavation the systems need to be distinguishable from one another and hence are often colour coded or individually identified with marker tapes to assist with the identification of the pipeline contents.

There is no Australian (or International Standard) that comprehensively addresses the identification colours for buried infrastructure. Compounding this situation there is no single industry or industry group that covers all infrastructure applications. During the preparation of this document two of the key industry groups were consulted – Energy Networks Association (ENA) representing gas and electricity utilities and the Water Services Association of Australia (WSAA) representing urban water utilities.

This document examines the main forms of pipeline identification and collates the available information of external colour of PVC and PE pipe for buried network infrastructure. It is an informative document only and should not be interpreted as a specification.

IDENTIFYING BURIED PIPELINES

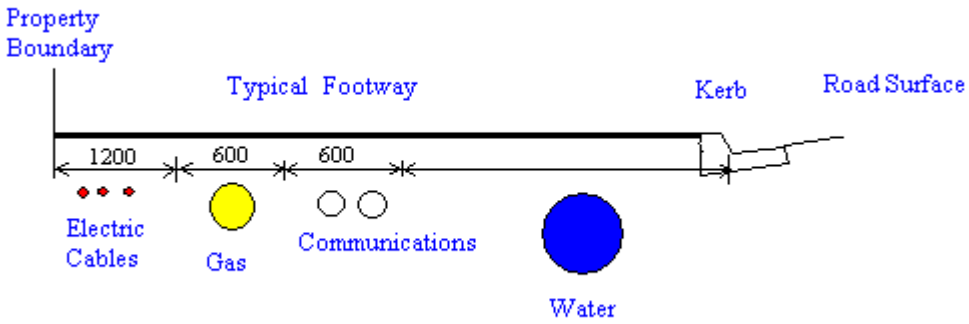
Pipelines are buried in a variety of locations – under footpaths of suburban streets, under roadways, through parkland and broader greenfield areas. Two of the primary mechanisms for pipeline identification are their physical location and their colour.

Most utility agencies rely on detailed geographic information systems that position the infrastructure on a plan. When the infrastructure is to be exposed the exact position of the network (and the networks of other agencies) needs to be determined and carefully excavated. Aspects of each infrastructure system can be used to assist in this process of determining the exact position of the assets in association with active locating techniques.

Information that aids the positioning and identification of buried infrastructure includes:

Footway Allocation

Many cities follow a convention for the location of network infrastructure. The following is a typical layout but the specific arrangements for each site must be confirmed with each agency. This can be used as a starting point in suburban areas to look for surface fittings or surface features that are unique to the infrastructure in question. Usually only reticulation networks are located in these allocations, trunk, feeder or major network assets often do not fit with these reticulation allocations.



Surface Fittings and Kerb Marking

Most infrastructure networks have surface structures or fittings at regular intervals. These provide further information about the location and identity of the infrastructure below. For example:

- Sewers and stormwater pipelines have maintenance structures which come to the surface and are protected with a surface cover.
- Telco's or communications have surface boxes or pits
- Gas pipelines have indicator posts or surface covers for buried fittings
- Water pipelines have hydrants and valve covers at regular intervals on reticulation networks
- Road crossings are often marked on the kerb

Marking Tape, Tracing Tape and Tracer Wires

Pipelines are often identified by marking tapes laid during construction just above the pipeline. These tapes usually include labels identifying the contents of the pipeline below. Tapes often incorporate a wide open mesh that is easily caught by excavators – see photograph below.

Marking tapes can also contain wires that facilitate pipe location. The wires are embedded in the main body of the tape and are usually terminated at convenient locations such as surface fittings which allow easy connection to the locating

equipment. Tracer wires can also simply be laid with the pipe or wrapped around the pipe during construction.

Marker tape being installed in the trench above the pipe (photograph courtesy of Iplex Pipelines

Active Location

The identification of pipelines often involves their precise location using some form of active locating device from the surface. The most common method involves the generation of an electrical signal in the tracer wire. This signal can then be monitored from the surface and the pipeline positioned for alignment and depth. An alternative to generating an electrical signal in the tracer wire is either the use of a sonde (a device introduced into the pipe and subsequently monitored from the surface – common in non pressure systems) or the monitoring of generated pressure pulses in a pressurised liquid pipeline.

Colour Coding Systems

In the context of pipeline colours and identification there are a number of standards referenced. Product standards in some cases nominate colours or colour options. WSAA have a suite of PurchaseSpecifications that also nominate colours for some pipe systems. AS 1345 is often referred to by specifiers but has limited application to buried infrastructure. The referenced colours are generally linked to either AS 2700 or the RAL colour system. CMYK and Pantone are also relevant in the context of colour specification. The following is a brief summary of these reference standards:

1. **AS 1345 : 1995** *Identification of the contents of pipes, conduits and ducts*. AS 1345 is often referenced notwithstanding that its scope states "*It is not intended to apply to buried or normally inaccessible services. However, the general principles may be applied when considering those services*". The standard is primarily applied to above ground pipe work within a plant environment that is normally accessible. For instance, the water service pipework within a house falls within the definition of "normally inaccessible" given in AS 1345.

   AS 1345 groups many products together that the infrastructure agencies need to separately identify. For example, in AS 1345 the basic identification category of WATER covers – drinking water, waste water, cooling water (including sea water), heating water, storm water, hydraulic power supply and recycled water. In all cases the identifying colour is green. Clearly such a definition of water is not appropriate to network infrastructure. Fortunately gas (yellow), electricity (orange) and communications (white) align broadly with these colours. However, there are many colours in AS 1345 that do not align—

   - green, as was mentioned above, covers all forms of water;
   - blue is for compressed air, vacuum and ventilation;
   - violet (close to purple) is for acids and alkalis; and
   - grey is for steam.

2. **RAL Colours** This is a German series of colour standards that have been established for over 70 years. RAL has been adopted by the polymer manufacturers in Europe as the standard reference for colours. There are two colour series that are referenced typically – the RAL Design Series and the RAL Classic Series.
   - The 4-digit RAL Classic Series of Colours has been the standard for choosing colours for more than 70 years. Originally the colour collection consisted of 40 different colours, today it is more than 200. They also contain safety and signalling colours and fulfil the colour requirements of DIN regulations.
   - The RAL DESIGN System has been developed for professional colour design. It contains 1688 colours arranged in a systematic order. All these 7-digit colour shades are defined as individual RAL Colours. The difference between this and the RAL CLASSIC colour collection is that the colour codes of the RAL DESIGN System are not arranged arbitrarily. They indicate the technologically measured values of Hue, Lightness and Chroma. RAL 210 60 30 for instance is a colour shade with a Hue of 210, a Lightness of 60 and a Chroma of 30. In case you would like to combine this colour shade with a lighter one, you could choose RAL 210 70 30. You would therefore get a colour with the higher Lightness 70. The other two features of the two colours would remain unchanged.

3. **CMYK** CMYK is an acronym for cyan, magenta, yellow and black. These are four colours used on a printing press. They are applied in micro dots at different percentages to form the colours seen by the naked eye. CMYK is not commonly used in the polymer or pipe industries. It is possible to convert a RAL specified colour to a CMYK equivalent by referring to a Pantone Colour Chart.

4. **Pantone** The Pantone Matching System (simply referred to Pantone or PMS) is the spot colour standards developed for the printing industry. A pantone colour is specified in the printing industry when a precise colour is required by application of a specially mixed ink. The colour swatches available from Pantone show the nearest equivalent CMYK but there is no direct correlation with RAL. The best way to colour match between RAL and Pantone is to look for similar colours in the RAL and Pantone colour charts.

5. **AS 2700 : 1996** *Colour Standards for general purposes*. AS 2700 defines 206 reference colours to assist with the specification and matching of colours used in industrial, architectural and decorative areas, with particular emphasis on

paints and related materials. It provides an explanatory text with tabulated colour data and practical equivalent colours, together with a foldout chart which gives a general indication of the range of colours. It essentially fulfils the same role as the RAL colour reference standards.

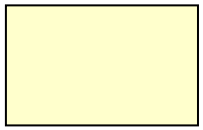
Current Colour Coding Practice

Table 1 summarises the principal basic colours currently used to identify buried network infrastructure. Some product standards and/or specifications nominate specific colours and, where this has been done, the relevant reference is included.

The colour can be either a solid colour, a coloured external jacket or profile, or in the case of PE pipe, coloured stripes on the outside of a black pipe. Generally fittings do not need to be colour coded. Included with Table 1 is a series of relevant notes and anomalies related to colour coding.

TABLE 1- BURIED INFRASTRUCTURE PIPE COLOURS

Application	Colour	Specific Colour Details		Comments
		Aust Standard	WSAA Purchase Spec	
Drinking Water (Potable Water)	Blue  White 	PVC-U (AS/NZS 1477 Series 2) and PVC-M (AS/NZS 4765 Series 2) – blue - nlt RAL 200 90 10 or RAL 210 90 10 ndt RAL 200 80 25 or RAL 210 80 25 PVC-O (AS/NZS 4441) – blue PE (AS/NZS 4131) - black with blue stripes or coextruded solid blue - PE80 - ndt RAL 5012 PE100- nlt RAL 5005	Adopts the Australian Standard except where colour is not specified - see comments	• WSAA - blue for PE sleeving and copper service pipe. Sleeving is nlt RAL 240 70 25 – ndt RAL 240 60 40. Copper is nlt RAL 200 90 10/210 90 10 – ndt RAL 200 80 25/210 80 25 • WSAA - PE black with blue stripes for mains, black with blue stripes or solid blue for service connection pipes, PVC Series 2 solid blue • White (Series 1 PVC see note 4) • PE in solid black often used in larger sizes
Recycled Water	Purple 	PVC-U (AS/NZS 1477 Series 1 & 2) PVC-M (AS/NZS 4765 Series 1 & 2) – purple - nlt RAL 310 70 15 – ndt RAL 330 40 40 or RAL 310 50 30 PVC-O (AS/NZS 4441) – by agreement between purchaser and supplier PE (AS/NZS 4131) - black with purple stripes or coextruded solid purple - nlt RAL 310 70 15 – ndt RAL 330 40 40 or RAL 310 50 30	Adopts Australian Standard where purple specified, otherwise nlt RAL 310 70 15 – ndt RAL 330 40 40/310 50 30 or nlt P23 Lilac – ndt P24 Jacaranda (AS 2700)	• WSAA - purple for PE sleeving and copper service pipe - nlt RAL 310 70 15 – ndt RAL 330 40 40/310 50 30. • WSAA PE black with purple stripes for mains, back with purple stripes or solid purple for service pipes, PVC Series 1 & 2 solid purple

Application	Colour	Specific Colour Details		Comments
		Aust Standard	WSAA Purchase Spec	
Pressure Sewer	Cream 	PVC-U (AS/NZS 1477 Series 1 & 2) – cream - nlt RAL 080 90 20 –ndt RAL 075 80 20 PVC-O (AS/NZS 4441) – white or light grey PE (AS/NZS 4131) - black with coloured stripes or coextruded solid colour – colour by agreement between purchaser and supplier	Adopts Aust Standard for PVC where cream specified, otherwise nlt RAL 080 90 20 – ndt RAL 075 80 20 Adopts Aust Standard for PE where cream stripes specified, otherwise cream stripes nlt RAL 080 90 20 –ndt RAL 075 80 20	• WSAA – PE pressure pipe black with cream, Series 1 PVC solid cream • AS/NZS 4441 permits other colours by agreement between purchaser and supplier • Solid black PE pipe is also often used for these applications
Gravity Sewer (Utility) & Sanitary Drainage (Private)	Grey 	PVC-U (AS/NZS 1260 DWV) – grey nlt Pearl Grey N11 ndt Cloud Grey N22 - (AS 2700 colours specified) PE and PP (AS/NZS 5065) – colour not specified	Adopts Aust Standard for PVC PE and PP (AS/NZS 5065) - colour not specified	• AS/NZS 1260 also states that where specified, white may be used. • PP is currently supplied grey for gravity sewers • PE solid black often used
Stormwater	NA	PVC-U (AS/NZS 1254) – colour not specified - see comment PE and PP (AS/NZS 5065) – colour not specified	NA	• AS 1254 states colour can be anything so long as it is easily distinguished from DWV (AS1260) pipe. • PP is currently supplied black for stormwater drains • PE solid black often used
Electrical	Orange 	AS 2700 X15 (AS1345)	NA	• AS1345 does not cover buried infrastructure (see note 4).

Application	Colour	Specific Colour Details		Comments
		Aust Standard	WSAA Purchase Spec	
Gas	Yellow 	PE 80 ndt RAL 1018 (4130) PE100 nlt RAL 1033 (4130)	NA	• Some yellow PVC still used for gas but vast majority is PE
Communications	White 		NA	

Notes:

1. nlt – “not lighter than ” , ndt – “not darker than”
2. Fittings of all materials have no colours specified except the WSAA Purchase Spec states that PE fittings for recycled water shall not be blue.
3. AS 1345 is often referenced but in its scope states “It is not intended to apply to buried or normally inaccessible services. However, the general principles may be applied when considering those services”.
4. Series 1 PVC is white in colour and often used in regional areas for drinking water supply, as well as for stock and domestic supplies where managed by regional water agencies.

DISCUSSION

Many anomalies exist within Standards and specifications for the colour of pipes.

DI, steel, ABS, VC, concrete, PP, PE (non-pressure) and GRP are not required to be specifically coloured to provide identification to comply with their respective Australian Standards. In the case of water agencies the WSAA purchase specifications often specify colour for particular applications but not consistently for all pipe materials. There is an implied assumption that WSAA Codes will address pipeline identification by requiring such pipes to be identified by other means when installed e.g. marking tape, sleeving etc. However, Water Agencies in adopting WSAA Codes may relax such requirements.

There are also other anomalies. For example, whereas copper property services for water supply are required to be blue in recycled water areas, these services are not required to be identified by colour in standard reticulation areas. Where conduits are used for crossings etc, the conduits are not colour identified although the pipes within may very well be specifically coloured.

THE WAY FORWARD

Agreement needs to be reached across all utilities responsible for buried infrastructure on:

a) How **all** pipe and conduit systems (regardless of material) are to be located and identified – tapes, tracer wires, colours, footway allocations etc
b) Generic colours to be used for identification of **all** buried pipe and conduits (regardless of material), including any current colour contradictions e.g. white.
c) How to specify colours.
d) Acceptable means for colour identification, again for all pipe and conduit systems e.g. colouring pipe material, installation in a coloured conduit or sleeving, coloured marking tapes etc.
e) Application of acceptable means of colour identification to specific pipe and conduit systems.

Once agreement has been reached on these issues, the process of implementation through Australian Standards and industry codes, standards, specifications etc can proceed.