Site requirements

Trench materials

Modular trench drain systems are generally manufactured from either polymer concrete, GRC (Glass fibre Reinforced Concrete) or HDPE (High Density Polyethylene).

ACO Drain comprise **Polycrete®** *Channels*, trench bodies manufactured from polymer concrete. Other materials do not meet the compressive strength and thermal expansion properties required in commercial and industrial applications.

Cement concrete

Cement concrete is Portland cement mixed with aggregates. Generally used for large cast-in-situ slab applications, where mass is required for structural rigidity.

Complex formwork is required to construct cast-in-situ trench drains, which adds to installation time and labour costs.

Plastic

Plastic is commonly used in trench drains. It is a readily available economical material that is easy to mould.

When directly exposed, plastic has poor thermal properties. A trench drain of 30m in length, with an ambient temperature change of 24°C, can expand or contract up to 330mm more than the surrounding concrete slab.

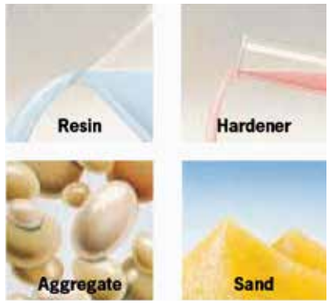
The concrete encasement will expand and contract minimally, causing the trench to buckle or pull away from the concrete.

When installed beneath the surface where only a metallic inlet slot is visible, the drain bodies should be designed with moulded features to key into the concrete.

Polymer concrete

Polymer concrete is a versatile composite material produced by mixing mineral aggregates with a resin binding agent. The finished material has excellent mechanical and thermal properties and offers good corrosion resistance to many chemicals, see chemical resistance chart on page 113. A maximum working temperature of 82°C is recommended.

Due to their structural rigidity, polymer concrete trench drains, when installed properly, can be used in a variety of pavement types such as concrete, asphalt and brick pavers.



GRC

Glass fibre reinforced concrete (GRC) is a mixture of cement, fine aggregate, water, chemical admixtures and alkali resistant glass fibres. GRC is predominantly used for building cladding panels.

GRC is a porous material that absorbs liquids which is not ideal for drainage.

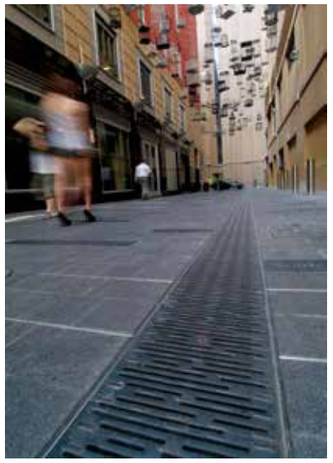
Channel edge

The exposed edge of the trench helps hold the grate in position and is subject to the same loads as the grate. In addition to the effect of climate and weight of vehicles, it may be exposed to impact from items being dropped or pulled across it (e.g. skips). If an edge fails, the grate will move and cause catastrophic failure.

Metal edges are used to withstand the abuse of traffic and are commonly made from galvanised steel, stainless steel and ductile iron. Edge protection rails should be integrally cast-in to the trench body.

Edge rails also provide some protection during installation, particularly if the wearing course of the pavement is not applied immediately. Appropriate edge protection is particularly important in asphalt situations where rolling machines can damage edge rail, leading to premature failure of the trench drain.

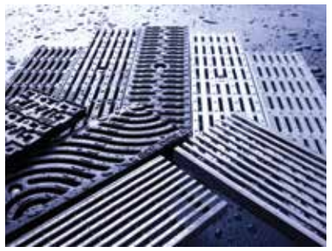
See page 126 for more information.



Grate materials

Grates are manufactured from a variety of materials. The most common are ductile iron, mild steel, stainless steel and plastic.

Grates need higher tensile properties than the trench body to withstand direct loads. Grates can be removed, changed or easily replaced after installation, unlike the trench drain body.



ACO Technical Services – Trench drain material comparison

The performance properties of trench materials

Different materials offer different surface and physical performance properties which may affect their suitability of use in various applications. These charts provide a side by side comparison. ACO can provide documentation to support these findings.

	Cement Concrete	Plastic (HDPE)	Polymer Concrete	GRC
Mechanical Properties				
Compressive strength The trench body is subject to compressive loads in use and needs to withstand the specified load.	25MPa	58MPa D-695	98MPa C-579	50MPa
Flexural strength Affects site handling and when trench body is in areas where encasement and soils are suspect.	3MPa	15MPa D-790	26MPa C-580	12MPa
Tensile strength Not generally required in trench bodies, but relevant to grates. Used as material measurement.	2MPa	14MPa D-638	14MPa C-307	5.5MPa
Thermal Properties				
Water absorption The trench is designed to carry and collect liquids without contaminating surrounding soil/encasement.	<3%	+0.31% D-570	+0.07% C-97	12%
Freeze-thaw Inability to withstand freeze-thaw cycles causes surface spoiling and leads ultimately to trench failure.	300 cycles maintain 80% structural integrity	223 cycles FAILED modulus of elasticity test C666	300 cycles modulus of elasticity 95.1% C666	modulus of elasticity unchanged
Coefficient of expansion/contraction Excessive movement between trench and encasement materials creates unwanted stresses which may lead to failure.	10 x 10^{-6} per °C	209.8 x 10^{-6} per °C E831	45.6 x 10^{-6} per °C E831	20 x 10^{-6} per °C
Water vapour transmission WVT is measurement of water vapour flow through a material. Passage of water vapour may be critical in some instances.	See water absorption test	WVT - 0.1392g/m² 1,592hrs E96	WVT 0.0364g/m² 1,592hrs E96	1 x 10^{-4} gm/s.MN
Surface Properties				
Surface burning Trench systems are often used around petrol stations, chemical processing and interior applications and may be subject to fire. They should be non-flammable and not give off fumes or smoke.	Non-combustible	After flame time : 390 seconds - fail UL-94	Flame spread : 0 Smoke density : 5 E84	Non combustible Ignitability : P Fire propagation : 0 Flame spread : 1 BS476
Weathering The majority of trench drains are used in exterior applications. The ability to withstand adverse weather conditions will ensure long service life, for example erosion, UV degradation etc.	Good depending upon proper curing	1000hr exposure no change G-154 FAILED TEST	2000hr exposure no change G-153	Similar to cement concrete. UV stable
Coefficient of friction (Manning's) Any degree of friction will affect liquid flow to some extent, therefore the lowest value is desirable.	n=0.013	n=0.010	n=0.011	n= 0.012
Chemical resistance Trench may be used for liquids other than water and in such circumstances, needs to be resistant to a variety of mediums. See page 113 for details.	Poor	Good	Good	Poor - better than cement concrete

Key: Good Acceptable Poor

Note:
1. Cement concrete values obtained from AS 3600 and SA HB 64 Guide to Concrete Construction (Cement & Concrete Assoc. of Australia).
2. HDPE values obtained from experimental data using ASTM testing procedures.
3. Polymer concrete values obtained from experimental data using ASTM testing procedures.
4. GRC values obtained from Design, Manufacture & Installation of Glass Reinforced Concrete (GRC Industry Group of NPCAA).

Sustainable drainage

In a perfect world, permeable landscapes would be everywhere allowing nature to work as intended. However, this is not possible and hard landscapes are common.

Sustainable drainage is the collection of rainwater for reuse. Water Sensitive Urban Design (WSUD) is a land planning and engineering design approach that integrates the urban water cycle including stormwater and groundwater to minimise environmental degredation and improve natural and recreational areas.

WSUD involves collecting water runoff that may or may not contain pollutants, cleaning the water, storing the water for future use or discharging the water in a controlled manner to receiving waterways with minimal impact to the environment.

Cost effective water management drainage solutions can be used to assist the 'collect' part of this process.

Trench drainage solutions are ideal as they enable maximum liquid collection and can form a barrier to prevent runoff flowing onto sensitive environmental areas and soft landscapes.

Trench drains are also very effective where there is a high risk of toxic pollutants entering the environment, for example highways and petrol stations.

EPA requirements

Stormwater runoff is generated from heavy rainfall flowing over land or impervious surfaces which has not infiltrated into the ground.

In urban areas such as pedestrian pavements, roads, car parks and building rooftops, the runoff can accumulate debris, chemicals, sediment and other pollutants that could adversely affect the water quality if discharged untreated.

Trench drains in high risk areas, for example petrol stations and airports, should drain into oil-water separators to remove hydrocarbons and other pollutants. For more information, contact ACO.

Retention, detention and infiltration

Sustainable surface water management goes beyond simply the collection of runoff.

Plastic geocellular systems with flow control devices can effectively influence the negative impact of stormwater, such as flooding to downstream catchments.

These systems can also harvest water for parklands, sports fields, agriculture and gardens. For more information, contact ACO.

Chemical resistance

ACO Drain channel bodies are highly resistant to chemical attack and with the appropriate grate can be used in most environments where everyday acids and diluted alkalis are encountered.

Different materials have different surface and performance properties which may affect their suitability for various applications. Refer to the chemical resistance chart on the opposite page.

Contact ACO for information on ACO's stainless steel or monolithic range of channels if the standard product range does not meet the required chemical resistance for the project.

Important considerations for chemical environments

When reviewing potential applications of trench drains in chemical environments, consider the following issues:

1. Type and mixture of chemicals.
2. Concentration percentages.
3. Contact time with the trench drain.
4. The temperature of chemicals constantly flowing into the trench drain (82°C maximum for polymer concrete).
5. Flushing system employed to clear chemicals from the system.
6. Cleaning agents should be checked for compatibility with trench drain material.
7. Polymer concrete samples can be provided to test the chemical resistance of the material.
8. Grate, locking mechanism, edge rail, outlet and rubbish basket should be checked for chemical resistance.
9. Check sealant for compatibility with trench drain, if applicable.

ACO Technical Services – Chemical resistance chart

The recommendations below are a guide only. Customers are advised to test a sample of polymer concrete to ensure its suitability for the intended application. Samples of polymer concrete are available for testing free of charge from ACO.

Chemical	Maximum Concentration	Short Exposure 72 Hours	Long Exposure 42 Days
Acetic Acid	30%	✓	✗
Acetone	10%	✓	✗
Ammonia	10%	✓	✗
Aniline	100%	✓	✗
Aniline in Ethyl Alcohol	10%	✓	✓
Benzene	100%	✓	✗
Boric Acid	100%	✓	✓
Butyric Acid	25%	✓	✓
Butyl Alcohol	100%	✓	✓
Calcium Chloride	100%	✓	✓
Calcium Hydroxide	100%	✓	✗
Caster Oil	100%	✓	✓
Chloric Acid	5%	✓	✗
Chromic Acid	5%	✓	✓
Citric Acid	100%	✓	✓
Diesel Fuel	100%	✓	✓
Ethanol	100%	✓	✗
Ethlendiamine	100%	✓	✓
Ethyl Acetate	100%	✓	✗
Ferrous Sulfate	30%	✓	✓
Fluorallic Acid	10%	✓	✓
Formaldehyde	35%	✓	✓
Formic Acid	10%	✓	✗
Fuel Oil	100%	✓	✓
Gasoline	100%	✓	✓
n-Heptane	100%	✓	✓
n-Hexane	100%	✓	✓
Hydraulic Oil	100%	✓	✓
Hydrochloric Acid	10%	✓	✓
Hydrofluoric Acid	5%	✓	✗
JP4	100%	✓	✓
JP8	100%	✓	✓
Lactic Acid	10%	✓	✓
Methanol	5%	✗	✗
Methyl Amine	100%	✓	✗
Methyl Ethyl Ketone	100%	✓	✗
Mineral Oil SAE5W50	100%	✓	✓
Monochlor Benzene	0.05%	✗	✗
Monochloroacetic Acid	10%	✓	✓
Nitric Acid	10%	✓	✗
n-Nonane	100%	✓	✓
Iso-Octane	100%	✓	✗
Oxalic Acid	100%	✓	✓
Phenol	100%	✓	✗
Phosphoric Acid	10%	✓	✓
Potassium Hydroxide	10%	✗	✗
Sodium Acetate	100%	✓	✗
Sodium Carbonate	20%	✓	✓
Sodium Chloride	100%	✓	✓
Sodium Hydroxide	15%	✓	✗
Sodium Hypochloric	5%	✓	✓
Sulfuric Acid	40%	✓	✓
Tetrafluoroborsaure	20%	✓	✗
Toluene	100%	✓	✗
Trichloroethylene	100%	✗	✗
Triethylamine	100%	✓	✓
Xylene	100%	✓	✗

Note: Maximum operating temperature of 82°C