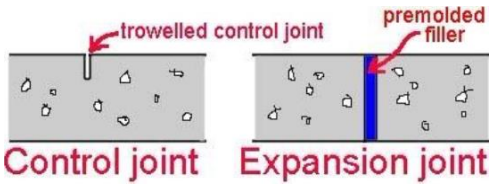
SRO1283 – Joint Treatments (Floors)

Scope
This document covers the treatment of 'joints' in floors with sealants, mortars, and concrete repair products.
It is limited to joints in concrete, mortar, screeds and cement-based levelling compounds.

Joints in construction or renovation projects generally tend to be:

- **Control Joints** (controlling shrinkage cracking) that penetrate to a minimum 25% of the depth of concrete slab. Control joints are used to control shrinkage during curing.
- **Expansion Joints** (controlling substrate expansion and contraction) that penetrate through the entire thickness of the slab. Expansion joints, also known as movement joints are used to control both shrinkage and expansion due to temperature variation and moisture ingress over time. Often wide, they are intended to accommodate movements that exceed those associated with the masonry itself.



Control Joint versus Expansion Joint

The location of control and expansion (movement joints) in domestic applications is related to panel size and thickness**.** The design criteria of the structure and the building materials used are the critical factor in the location of expansion joints in commercial situations.

There are other joints not specifically dealt with in this System Recommendation. They are:

- Bond breaking joints between adjacent surfaces (e.g., walls and floors)
- Isolation joints which are used to isolate fixed objects, providing for slight differential settlement without damaging the concrete (usually pavement).
- Cold joints are planes of weakness in concrete or mortar caused by an interruption or delay in the installation.

Control Joints

These are used to compensate for movement when concrete shrinks during curing. Cracks that occur during curing when concrete shrinks are controlled in specific locations by forming, tooling, sawing or placing joint formers. The pre-planned cracks provide a better finished concrete product and their known locations enable these

cracks to be monitored. Saw-Cut Joints are generally filled with rigid materials after 28 - 42 days of cure have elapsed from the time of the pour (e.g. **ARDEX RA 54**, **ARDEX RA 56** or **ARDEX RA 88**). This is generally prior to the application of a subsequent topping that is to be installed on the panel. Tooled and inserted joint former type joints do not require filling with a sealant as the concrete is generally left uncovered.

Note: It is important to recognize that using steel reinforcement in a concrete slab actually increases the potential for the occurrence of random hairline cracks in the exposed surface of the concrete.

Summary
There are three common types of control joints. They are 'Tooled', 'Inserted' or 'Saw-Cut'. A brief summary of each is as follows:

Tooled Control Joints
These are cut into the surface of the slab with a hand groover or walking groover tool.

Advantages
- Simplest to make
- Most reliable crack initiation

Disadvantages
- Most noticeable joint
- Not smoothest for rolling wheels
- Not designed for sealers/fillers

Inserted Control Joints
Pre-formed fibre-boards or similar are inserted into the surface of the slab.

Advantages
- Almost invisible
- Somewhat resistant to intrusion of water and debris even when unsealed
- Provides good rideability
- Reliable crack initiation
- Fast and economical

Disadvantages
- Learning curve for installation crew
- Can ravel or spall if not installed plumb

Saw Cut Control Joints
Cuts are made into the surface of the slab with a concrete saw.

Advantages
- Makes best sealant reservoir
- Not as noticeable as tooled
- Smoothest for wheels

Disadvantages

- Timing is critical to success with least reliable crack initiation when gravel aggregates are used
- Expensive to make

Control Joints – Thickness

Saw-Cut: This type of control joint is generally as wide as the width (3mm – 5mm) of a diamond concrete saw blade. A tuck point grinder or slotting tool with dust shroud is the best option regarding dust minimisation while allowing the depth of the cut to be set. The depth of the cut must be a minimum of 25% of the full concrete or mortar depth. A depth of 33% is recommended as ideal. This means that any tool that will accept a diamond saw blade suitable for cutting concrete can be used to create saw-cut control joints. This type of joint should be left to cure for 28 days (min) before being filled with a semi-rigid joint filler.

The timing for cutting the concrete or mortar varies depending on the temperature and the relative humidity, but the window is generally **4 to 12 hours** after concrete placement. The rule of thumb is that the joint can be cut as soon as the concrete is firm enough to support the saw.

Tooled: A Control Joint can be tooled with a typical width of **3 – 12mm** into the concrete surface at the time of placement. There are specific tools for doing this. The same rules apply as above. i.e., the depth of the joint must be a minimum of 25% of the full concrete or mortar depth. A depth of 33% is recommended as ideal. This type of joint is generally not filled with a sealant or filler.

Inserted: A suitable joint forming product (e.g., plastic, pressed metal or hardboard strip) is inserted at the time of the pour. It will typically be 3 – 10mm in thickness. It is inserted to a minimum of 25% of the full concrete or mortar depth. A depth of 33% is recommended as ideal.

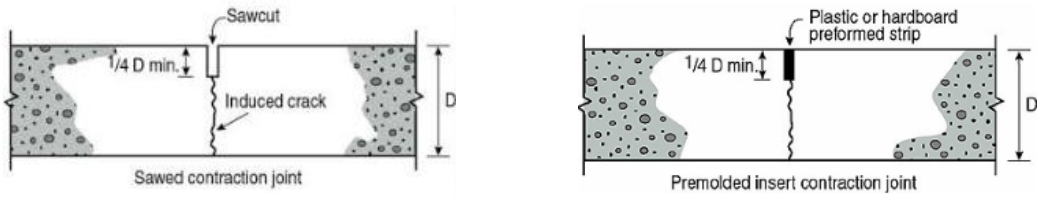
Control Joints - Dimensions and Spacing

The spacing of Control Joints is related to the thickness of the concrete or mortar slab. It is generally 20 – 25 times the thickness of the slab. Ardex generally state that 4.5m is the maximum allowable spacing.

A table of control joint spacing recommendations (attached) appears in the reference document;

'Concrete Jointing and Details: Thickness is Only the Start.'
Author: Brian Killingsworth, P.E.
Senior Vice President, Local Paving
National Ready Mixed Concrete Association - USA

Slab Thickness	Maximum Joint Spacing
100mm	2.4m
125mm	3.0m
150mm	3.6m
180mm	4.2m
200mm	4.5m



Saw-Cut and Inserted Control Joints
(Ref: everything-about-concrete.com)

Filling of Control (Contraction) Joints

Once the joint is cut or tooled into place, it is ready to do its job. The joint can then be left as it is, sealed, or filled. Sealing or filling should be put off as long as possible to allow the joint to widen, although in practice joints are usually sealed or filled sooner than ideal.

Surface Preparation (28 days minimum)

The walls of the control joint must be clean and completely dry with no presence of moisture. The surfaces must be sound and clean with no dust, dirt, grease, wax, oil, or any other contaminant present.

Understanding the difference and the purpose of sealing or filling is important. Sealing is done in movement joints with a flexible (elastomeric) material typically installed over a backer rod to give the seal the proper shape in the joint. Filling however, is done in control joints to the full depth of the joint with a material that has enough compressive strength to support the edges of the joint from stresses imposed by heavy, hard-wheeled traffic. Joints in slabs that will not be subjected to heavy hard-wheeled traffic can safely be left unfilled or can be sealed with a flexible sealant.

A saw-cut control joint is generally filled with a semi-rigid joint filler. This is not the case with inserted or tooled control joints.

Control joints in concrete, mortar beds, screeds and toppings may be filled after 28 - 42 days of cure have elapsed from the time of the pour.

Joint Detailing

The use of a backing rod as a bond breaker is not a preferred option in control joint applications. Traffic load forces are often too severe without the joint being filled to its full depth. This is because the joint spall could break off the joint edge below the backer rod. Full-depth filling provides support to the joint edges all the way to the bottom of the saw cut.
(Ref: VersaFlex Incorporated – Filling Control Joints Jan 27, 2017)

Suitable Products

For saw-cut control joints it is generally best to use a suitable ‘semi-rigid’ joint filler. The best materials tend to be 100% solids epoxy fillers or polyurea fillers.

Control joint filling materials have different, more robust physical properties than joint sealants. Joint sealants are soft and offer no edge support. The rigid products generally used for control joints offer good edge support without the elongation properties of a joint sealant.

The ARDEX products recommended for control joints are:

ARDEX RA 54 – High Strength semi-rigid Polyurea (internal and external)
ARDEX RA 56 – High Strength rigid hybrid Polyurethane (internal and external)
ARDEX RA 88 – High Strength rigid Epoxy (internal and external)
ARDEX A45 – Cementitious patching compound (dry internal)

Note: It is wise to note the location of control joints and where possible align them with grout joints when tile finishes are used. The grout line could be filled with a colour matched silicone sealant.

Expansion (Movement) Joints

An expansion or movement joint is designed to safely absorb the moisture or temperature-induced expansion and contraction of concrete and mortar slabs. It is also designed to absorb vibration, hold parts together or to allow movement due to ground settlement or earthquakes.

A movement joint is a permanent gap between two immediately adjacent concrete panels that is kept completely free of mortar. It is generally filled with a flexible building sealant or silicone to keep it water-tight. The inclusion of a movement joint ensures that any movement in the pre-sized panels does not cause cracking within the panel or in any subsequent topping that has been installed on the panel. A movement joint is always telegraphed all the way through the slab or mortar bed and any subsequent toppings that are installed upon them (e.g., levelling products and tile finishes). If a topping is to be placed on top of the concrete then existing subfloor joints (whether they correspond or not with where the topping joints are meant to be) must also be carried through the topping.

Typically this process entails either detailing the joints beforehand with edge strips (if permanent), or pouring the topping and then cutting the joints to the full thickness of the concrete or mortar bed the day after it is poured (when hard enough to take the weight of a diamond floor saw).

Movement Joints - Dimensions and Spacing
The theory is to create concrete or mortar ‘fields’ that can absorb differential movement within the substrate. These are installed in certain areas and positions to prevent the substrate from cracking. In many cases this can also be beneficial in preventing any topping surfaces (e.g. tiles) from cracking. The exact positioning of the movement joints is vital to them successfully protecting the installation. If they are installed in the wrong place they won’t work.
(Ref: Schluter Systems – Innovative Installation Systems for Tile and Stone)

Domestic Applications

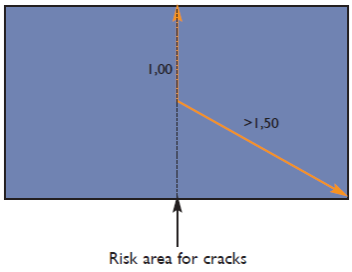
Movement Joints – Thickness

General Guide (Domestic application): The width of a Movement Joint in millimetres should be about 30% more than the value of the distance between joints in metres e.g. Movement Joints at 10m centres should be about 13mm wide.
(Ref: Building Control – Eden District Council, Cumbria United Kingdom)

Industry guidelines suggest that the maximum field size should be no more than 8 - 10 metres in each direction with 100m² being the maximum size. In practise the standard field size tends to be 5 - 8m in each direction with 64m² being the maximum size. These panels would be likely to contain smaller fields defined by the control joints with spacing determined by the slab thickness.

If there are suspected to be other factors (e.g. subsidence or seismic activity) that may lead to movement beyond conventional temperature related expansion and contraction then the advice of a structural engineer should be sought.

Generally the concrete or mortar slab field should be kept as square as possible as cracks are probable if the ratio of the shortest to the longest distance from the centre of the panel exceeds 1:1.5



(Ref: Schluter Systems – Ceramic Tile Movement Joints – Why, Where, How)

On suspended floors, stress relieving movement joints should be inserted where flexing is likely to occur. This could be over supporting walls or beams. Movement joints should also be installed where there are any changes in the substrate (e.g. timber to screed).

For areas less than two metres wide perimeter (isolation) joints are not normally required unless conditions generate stresses which are likely to be extreme, for example temperature changes.

Areas greater than two metres wide must have perimeter joints inserted. These must completely isolate the floor slab from any adjacent walls. Perimeter joints are generally 6mm wide and are telegraphed through the full depth of the slab.

Industrial and Structural Applications

Joint Spacing
Recommendations for definitive joint spacing should be ascertained by the design engineer. The engineer will calculate the spacing based on the composition of the concrete or mortar which will have a specific coefficient of thermal expansion and therefore a predictive expansion and contraction proportionate to temperature change.

The other influencing factor will be whether the panels or bays will be tied together by post tensioning. e.g., on bridge walkways. The third consideration is whether or not the substrate in question will have an initial one off shrinkage to include in the calculation. e.g., a concrete pavement slab may have an initial shrinkage of 600 microstrain (0.6mm) at 28 days. This will be also considered by the design engineer when calculating bay sizes. It is difficult to know all the information related to an installation so the spacing of joints needs to be dictated by the design engineer for the above reasons.

Joint Width
The width of the joints will be calculated by the design engineer based on the expected movement and the movement capacity of the sealant to be used.

Surface Preparation
The walls of the expansion joint must be clean and completely dry with no presence of moisture. The surfaces must be sound and clean with no dust, dirt, grease, wax, oil, or any other contaminant present.

Suitable Products
Movement joints in concrete, mortar beds, screeds and toppings may be filled with flexible materials after 28-42 days of cure have elapsed from the time of the pour.

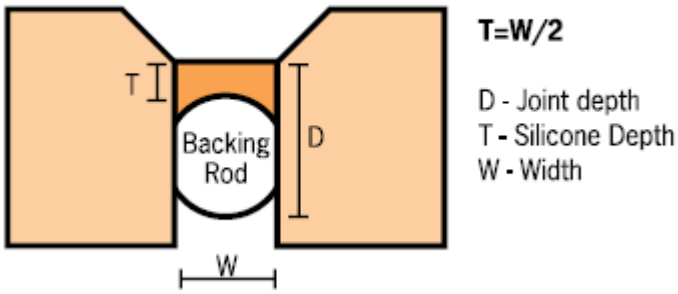
ARDEX RA 030 – Flexible Polyether Building Sealant (internal and external)
ARDEX RA 040 – Flexible Polyurethane Building Sealant (internal and external)

ARDEX ST Silicone – Neutral Cure Silicone Sealant (Internal and external)
ARDEX SE Silicone – Acetic Cure Silicone Sealant (internal and external)

The bottom of the movement joint should be filled with sand or a pre-fabricated backing rod. The sand and/or the backing rod control the depth of the sealant as well as preventing ‘three sided’ adhesion which could cause a failure.

The backing rod is placed just below the joint surface to ensure that the sealant, when installed, will have a width to depth ratio of 2:1. Maximum width using this system is typically 30mm.

Optimum Joint Design



(Ref: ARDEX Data Sheet – ARDEX SE Silicone)

Sealant Considerations

The role of the joint sealant is to minimize infiltration of surface water and non-compressibles into the concrete or mortar joint. Non-compressibles cause point bearing pressures which may lead to spalling and when longer joint spacing is used, 'blow ups'. Where joint sealants are specified, the expected joint movement should be a factor in the selection of sealant material.

Note: ARDEX do not have a sealant that is suitable for potable water applications

Other Joint Types (Summary)

Bond Breaking Joints

Bond breaking joints typically involve a 6mm gap between vertical and horizontal surfaces. They are installed because movement in a vertical direction is often different to that experienced in the horizontal direction despite the two surfaces being adjacent. The installation of a rigid mortar or grout in these gaps invariably results in a failure. These gaps are generally filled with a neutral cure silicone or a polyurethane building sealant.

Isolation Joints

Isolation Joints are sometimes called expansion joints but should generally not be used to provide for expansion. They provide no load transfer and should not be used as regularly spaced joints in a joint layout. Their proper use is to isolate fixed objects, providing for slight differential settlement without damaging the concrete slab. They are typically used to isolate concrete pavement from adjacent concrete, mortar of brickwork The purpose of these joints is to allow movement without damaging adjacent structures.

Cold Joints

Cold joints are planes of weakness in concrete or mortar caused by an interruption or delay in the installation. This is generally when the first batch of concrete or mortar has begun to set before the next batch is added, so that the two batches do not intermix.

Tools Used to Create Concrete Joints

The following tools are normally used to create concrete joints, although these tools might vary depending on the size and scope of the project. Here are the most commonly used tools:

- Hand Groover or Walking Groover: The choice to use either of these depends on how large the slab is.
- Cordless control joint tools: Ideal for use on small to medium size projects.
- Concrete saw: Ideal for saw cutting concrete but it is wise to know how deep that cut needs to be. If this is not the case, problems could be created.

Disclaimer:

The recommendation selected is based upon questions answered on the ARDEX Australia website. This recommendation is designed as a general application for your described situation and should not be considered site specific documentation for general distribution. Always consult the latest relevant ARDEX Technical Bulletins and information on the product packaging and/or product data sheets (available on the ARDEX Website). Australian and other relevant standards should be followed during installation. If you have any further questions or would like further clarification please contact the ARDEX Technical Services Hotline on 1800 224 070 (9am to 5pm Monday to Friday).