



## **DYNACEM®** non-explosive demolition agent

DYNACEM is a highly expanding mortar for non-explosive demolition. It expands soundlessly, tears apart structural elements, separates reinforcing steel from concrete and it's easy to use:

1. Begin by drilling the holes:



2. Mix DYNACEM with water and pour or insert into the holes:



3. DYNACEM expands, BREAKS and TEARS APART boulders, rock and reinforced concrete:



**DYNACEM IS SEVERAL TIMES QUICKER THAN HAMMERING!**

Appropriate distribution of holes allows:

- breaking into large, or small pieces:



- splitting into sizes suitable for transport:



### ADVANTAGES:

- accelerates demolition,
- no noise, vibrations, sparks and exhausts,
- no heavy machinery,
- less hammering and energy consumption,
- no flying debris, fire and toxic gases,
- controlled path/run and pattern of cracking,
- controlled demolition zones,
- "cutting" along designated lines,
- breaking into desired sizes,
- no precautions and qualifications for handling explosive materials are required.

### APPLICATIONS:

- concrete demolition, rock breaking,
- rock excavation, splitting stones and boulders,
- dividing beams and foundations into pieces,
- breakouts and openings in slabs and walls,
- tunneling, trenching and rock excavation,
- removal of rocky humps and boulders,
- exposing and releasing steel reinforcement from surrounding concrete,
- cutting concrete piles,
- quarrying stone blocks with minimal waste.

**IDEAL SOLUTION** when machines, noise, or vibrations are undesirable.



## MATERIAL PROPERTIES AND HANDLING

**DYNACEM is a grey powder** that needs to be thoroughly mixed with water prior to filling the holes previously drilled in the element intended for demolition. As a result of a chemical reaction (hydration with heat evolution) DYNACEM hardens, anchors itself within the holes and expands. Volume increase is accompanied by an increase in pressure<sup>1</sup> exerted by DYNACEM on the walls of the hole. Pressure exerted by DYNACEM is a couple of times higher than the tensile strength of concrete, mineral construction materials and rocks. Once the pressure exceeds the tensile strength of the element, it breaks – gets torn apart as cracks form. They keep on growing as DYNACEM keeps on expanding. Further propagation of cracks lasts for a couple of days and can be accelerated by moisturising the holes with warm water once the product solidifies.

**DYNACEM versions<sup>2</sup>** are: STANDARD for temperatures -10 - 15 °C, SUMMER for 10 - 30 °C, and SUMMER+ for 30 - 50 °C.

**The time to crack formation usually ranges from a few to 24 hours<sup>2</sup>.** The key factors are: hole size, hole spacing, temperature and properties of the material being splitted. Hard and rigid materials (e.g. high strength concrete) usually fracture more easily than soft materials (e.g. lean concrete) that tend to deform, rather than break under pressure.

**30 - 40 mm diameter holes spaced 5 - 15 diameters away (15 - 60 cm) provide effective breaking capabilities in most practical applications.** It is, however, safest to account for **element temperature** (measured within the hole) and the **type of material being cracked** (concrete, r.c., rocks) in each case individually following the guidelines in the Table:

Set-up depending on temperature and type of material being cracked:		element temperature measured within the hole			
		below 0 °C - 10 °C - 15 °C	10 °C - 30 °C	30 °C - 50 °C	
- DYNACEM type		STANDARD		SUMMER	SUMMER+
- hole diameter <sup>3</sup>	reinforced concrete, granite, basalt, hard rock	5 cm	4 cm	4 cm	4 cm
	concrete, soft rock	4 cm	4 cm	3 cm	3 cm
- mixing water temperature <sup>4</sup>		warm	cold		
- mixing water per 5 kg of powder		see packaging			
- hole spacing	reinforced concrete, granite, basalt, hard rock	5 - 10 hole diameters			
	concrete / soft rock	10 - 15 / 10 - 20 hole diameters			
- minimum hole depth		5 hole diameters			

**CAUTION, increased hole diameter will result in increased DYNACEM reaction rate, higher temperature and stronger expansion. A diameter, which is too large, or using Dynacem above its application temperature range, may cause boiling, water vapour disengagement and sudden, dangerous hole blow-out,** especially in the summer or on sunny days.

**In order to decelerate the reaction and delay the formation of cracks:** decrease the hole diameter, mix DYNACEM with cold water and increase the hole spacing.

**In order to accelerate the reaction and formation of cracks:** increase the hole diameter, mix DYNACEM with warm water and decrease the hole spacing.

<sup>1</sup> Dynacem expansion pressure is thoroughly tested by our laboratory for each produced batch of product before it is qualified for sale - see Appendix to Dynacem Data Sheet on the end of this document.

<sup>2</sup> each version is fast performing at the top of its application temperature range (breaks rock within 6-18 hours typically, at hole diameter of 40 mm) and may cause dangerous blow-outs above its maximum application temperature. Reaction slows down and breaking time increases almost 2 times with every 5 deg C drop in temperature, or with a hole diameter reduction to 30 mm.

<sup>3</sup> when dealing with non-reinforced elements DYNACEM expansive grout can sometimes be successfully applied to holes of a diameter smaller than those given in the Table, especially when it's warm outside and the the holes are arranged in a linear pattern (e.g. when temperature exceeds 10/20 °C, holes of 30/25 mm are used in granite applications), or when increased cracking time is acceptable.

<sup>4</sup> adjust to keep the mixture of water and STANDARD version below 15 °C, water and SUMMER version below 30 °C.



### Drilling holes:

- measure the temperature within the first hole. Should the drilling method result in large heat evolution, wait and repeat the measurement after some time allowing the drilling heat to dissipate,
- use the Table above and adjust the hole diameter to the temperature within the element, not surrounding air temperature,
- expansion energy is utilised most efficiently, when the holes are perpendicular to the drilled surface, parallel to the nearest free surface<sup>1</sup> and away from it by 4 to 10 diameters,
- depth should be as large as possible and at least 5 times larger than the diameter,
- the product does not work in holes of length smaller than 5 x diameter,
- the easiest way to drill is to use pneumatic or hydraulic rock drills with drilling rods and chisel or cross bits e.g. WUP-22 (MOJ) or RH, BBD, DKR, LHD, Cobra (Atlas Copco),
- holes should be cleared of any water or dust. The inside surface can be dry, or moist, however should not contain any standing water,
- holes that were accidentally drilled all the way through can be plugged to prevent demolition agent DYNACEM from leaking before it solidifies,
- empty holes should be covered to protect against dust, sunlight, heat, or frost.

### Mixing mortar:

- use safety measures and personal protective equipment, as specified in the Material Safety Data Sheet,
- it is best to start with making a small, trial batch to fill a single hole before proceeding with the job,
- begin by calculating and weighting the quantity of DYNACEM powder and mixing water required,
- the smaller the amount of water used, the more powerful the product is. Use only enough water and mix only long enough for the mixture to take uniform, fluid texture similar to thick cream,
- approximate water dosage is given on the information sheet inside the cardboard box or on the plastic DYNACEM bags,
- only prepare as much mixed grout as can be used in 3 min. at most. The more DYNACEM/water mixture and the longer the time it sits in a single container, the higher the risk of the mixture heating up and reacting,
- before mixing each batch ensure that all the equipment (mixer paddles, vessels etc.) is perfectly clean and not contaminated with remains from the previous batch,
- within a span of 1 minute powder should be gradually added into a vessel containing water while being mixed slowly. Should the mixture become too dense, continue vigorous mixing to liquify it,
- it is best to use a plaster or paint power mixer rated at 1000W minimum, but it can also be done manually,
- by adding a little bit more powder and intensive manual kneading, the mixture can become almost plastic, which is useful when filling horizontal holes,
- avoid mixing fresh product with remains from a previous batch, extended mixing times (especially in the summer), using aluminium containers, mixing and storing tools, powder, or water in places receiving high doses of sunlight, or close to any sources of heat, as it may cause the chemical reaction to start prematurely, during mixing.

**CAUTION, if DYNACEM mixture heats up, "smokes", or rapidly dries up, stirring should be stopped immediately and the contents of the vessel should be spread on the ground.**

### Filling holes:

- use safety measures and personal protective equipment, as specified in the Material Safety Data Sheet,
- do not fill holes immediately after drilling, if the drilling method could have heated the element up,

<sup>1</sup> at all times, at least one **free surface** should be made available, i.e. a surface that can move without external resistance, as a result of DYNACEM demolition grout expansion. If such a surface is not available in the existing state (all surfaces are in contact to external obstacles), create it - see HOLE PLACEMENT section.



- check if the holes have not been contaminated since drilling and preparation, begin filling starting with holes near the free surface,
- the easiest way to fill the holes is to use a funnel and ensure the mixture is liquid in consistency,
- fill horizontal holes by plugging them with a PVC elbow, or by inserting handfuls of material mixed to a plastic consistency and packing tightly with a rod,
- do not fill the holes up to the top, leave 2 - 3 cm empty,
- long and narrow holes require liquid mixture and need to be vented to enable complete filling. Wire or a thin rod can be inserted into up facing holes and moved up and down repeatedly during filling,
- holes placed in a row to generate a single crack should be filled one after the other, without any delays,
- do not plug the filled holes. Instead, shield them from rain and sun with a bright colored tarpaulin for 12 hours, or cover completely for the duration of the job to protect from frost,
- filled holes can be flooded and left submerged in water if there is a need to do so,
- ensure that no one approaches the holes or looks towards them for at least 12 hours from filling,
- ensure that no one, under any circumstances (even when wearing protective goggles) looks directly into the filled holes,
- remains of the expansive demolition agent should be diluted with water and removed from the vessel to prevent contamination of the following batch.

**PRODUCT CONSUMPTION**

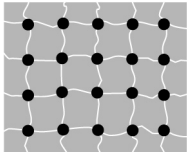
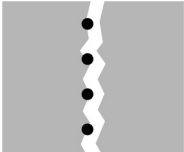
Dynacem powder requirement as a function of hole diameter:

- hole diameter:	20 mm	30 mm	40 mm	50 mm
- DYNACEM quantity required to fill a hole of 1 m length:	0,6 kg	1,2 kg	2,2 kg	3,4 kg

Dynacem powder requirement as a function of hole spacing in a square drill pattern:

- hole spacing in a square drill pattern:	7 x 7 diameters	8 x 8 diameters	10 x 10 diameters	15 x 15 diameters
- Dynacem powder per 1m <sup>3</sup> of concrete/rock:	28 kg	21 kg	14 kg	6 kg

Resulting consumption of DYNACEM as a function of desired way of demolition:

<p>- BREAKING is achieved by square drill pattern, which results in damage of the entire volume of the element. DYNACEM consumption is high.</p>  <p>Consumption is approximately equal to:</p> <ul style="list-style-type: none"> <li>- rocks: 5 - 20 kg/m<sup>3</sup></li> <li>- concrete: 5 - 15 kg/m<sup>3</sup></li> <li>- reinforced concrete: 10 - 30 kg/m<sup>3</sup></li> </ul>	<p>- SPLITTING is achieved by linear hole distribution, which results in the element being divided into blocks fit for loading and transport. Consumption is low.</p>  <p>Consumption is approximately equal to:</p> <p>0,5 - 5 kg/m<sup>3</sup></p>
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**HOLE PLACEMENT**

**Holes interact in formation of cracks.** Skilful hole placement allows achieving the desired demolition effects in a short time and at small cost.

**In rock and boulder breaking,** one central hole causes 3 or 4 cracks to form. Increasing the number of holes will result in more cracks and more chunks being formed.

In order for the cracks to develop and propagate, the element must have at least one free surface that is not in contact with any obstacles, so it can move without external resistance as the result of DYNACEM expansion.

**The best results** can be achieved drilling holes parallel to the free surfaces. In this case the entire expansion force moves the split fragments towards the free surface.

Option A: a rock is buried in the ground and the only free surface is the horizontal surface of its exposed hump. In this case horizontal holes are the best choice (often impossible to drill). Skewed holes are effective too, while vertical holes are completely ineffective.

Option B: excavating the rock on one side creates a free side surface and allows the vertical holes to become effective.

Option C: if a rock is completely excavated, or rests at the ground level, its entire surface is free and allowing every hole direction to be effective. Hole depth should exceed 50 % of the rock diameter.

**Slabs and concrete floors** contained by walls, or large layers of rock have only one, horizontal free surface and vertical holes are ineffective. Begin demolition by diamond core drilling a line of vertical, overlapping holes to create a free space, or by drilling a lines of skewed holes in order to form a breakout that will expose additional free free surfaces. Vertical or skewed holes can be used to demolish the remaining area.

Hole depth should be larger than 5 diameters and should exceed 80 % of slab thickness. Holes can be drilled at an angle in thinner slabs to increase depth.

**Square drill pattern** in a non-reinforced element causes breaking and destruction of its entire volume.

Hole spacing should not exceed 30 cm if you want to remove the rubble manually or with hand tools. Larger hole spacing, e.g. 40 cm, can be used when larger chunks will be removed by the excavator.

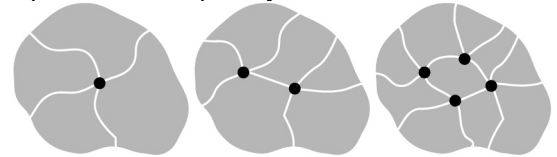
**Linear drill pattern** causes splitting of the entire element into blocks fit for loading, transport and further usage, as they are not cracked.

**Linear drill pattern** may result in a single or multiple cracks. The deciding factors are:

- L** - hole spacing (distance between holes in a row), and
- k** - burden (distance from a row of holes to the free surface).

placement allows achieving the desired

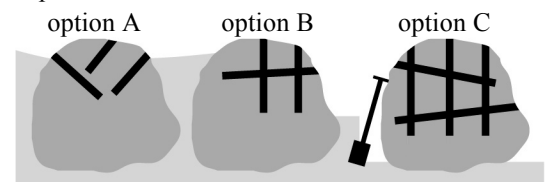
Options for hole quantity:



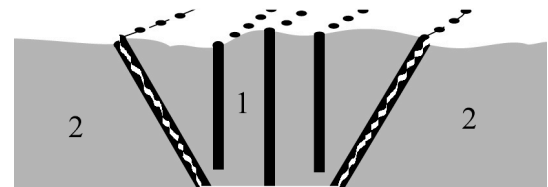
The number of holes is chosen with regard to the rock size and to desired chunks size (possibilities of loading, transporting, or usage them on site are important).

The distance between the external hole and the free surface (edge of the rock) should not exceed 12 diameters of the hole.

Possible placements and directions of effective holes in successive stages of excavation and expansion of the free surface.



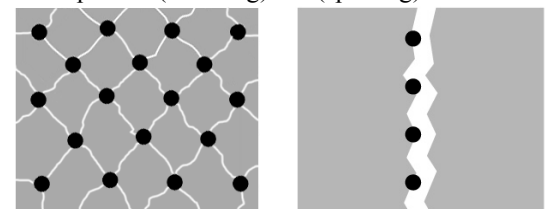
Skewed holes create a breakout in the mother rock or a concrete block. Pushing the “wedge” upwards, (towards the horizontal free surface) creates two additional, skewed free surfaces:



- 1 - additional vertical holes should be drilled when delaminating thick layers to aid the diagonal holes
- 2 - areas where using vertical holes is now possible

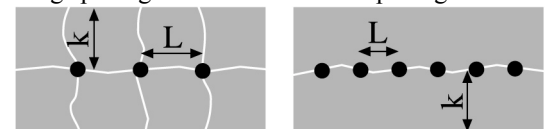
Options for hole placement:

- square or staggered drill pattern (breaking):
- linear drill pattern (splitting):



Options for hole spacing within a row:

- big spacing:
- small spacing:



$L \geq k$   
gives a main and perpendicular cracks,

$L < k$   
gives only a main crack.



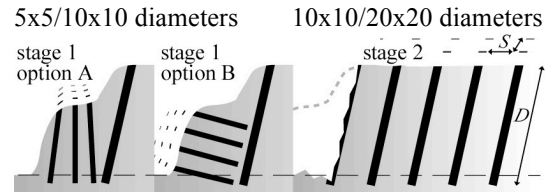
**Empty holes "repel" cracks.** A row of empty holes sets the breaking boundary.

Cracks do not propagate beyond the empty holes:



**Removing the top layer of a thicker rock mass** begins with drilling a few shallower holes to remove the toe and obtain a regular, vertical free surface of the cliff. Then more holes parallel to the new cliff surface, and reaching a few centimetres below the desired cut-off level, are drilled. One (best) or two consecutive rows are then filled up every 5 to 15 hours.

Hole spacing  $S$  in square drill pattern should never exceed the hole depth  $D$ . Furthermore, hole spacing should not exceed (for hard / soft rock):



5x5/10x10 diameters      10x10/20x20 diameters  
 Drilling depth: 80 - 85 % of the block height.  
 Block width: up to 300 cm (more may be possible).

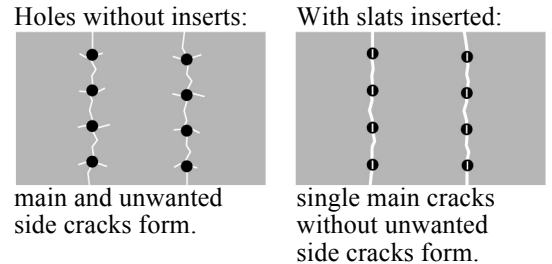
**Quarrying blocks of sandstone, granite, and marble** is conducted using rows of vertical holes. Common hole spacing is 10 hole diameters (7 diameters to obtain smooth splitting surface). Despite smaller amount of holes being drilled, the number of damaged (cracked) blocks is much smaller than when explosives are used.



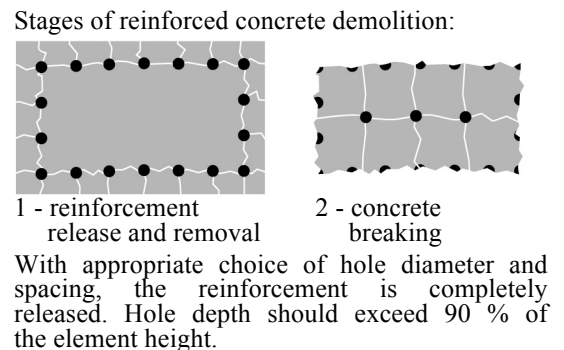
**Long concrete and reinforced concrete foundations and beams** can be demolished cheaply and quickly by **dividing into pieces**. Holes need to be drilled in a line perpendicular to the element. Inside and within the vicinity of resulting cracks, the reinforcement will be exposed and can be cut through very easily. DYNACEM may tear apart reinforcing bars up to 12 mm diameter.

When no natural horizontal cracks are present, a line of horizontal holes needs to be drilled:

When dealing with **reinforced concrete walls or slabs**, it is best to drill holes parallel to the element surface, situated in the middle of the cross section and behind, or between the reinforcement layers.

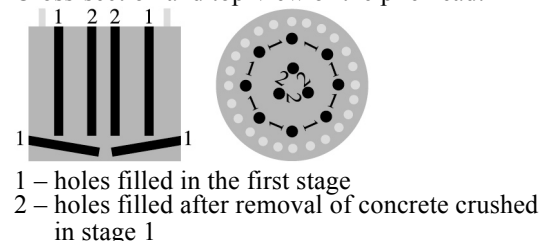


**To break a reinforced concrete element into small chunks**, it is recommended to start with making a single row of holes 4 diameters away from the edge of the element. Resistance of the internal concrete block causes the expansion pressure to crush the concrete between the holes and the element surface and to release the reinforcement. Then all that's left is to break, or split the remaining non-reinforced concrete block.



**Cutting through a concrete pile** begins with making the first cut-off crack (using holes drilled radially towards the centre of the pile) and with releasing the reinforcement (using vertical holes drilled right behind the reinforcing bars). Then the remaining stump is crushed.

Cross-section and top-view of the pile head:



1 – holes filled in the first stage  
 2 – holes filled after removal of concrete crushed in stage 1



## **SAFETY**

DYNACEM non-explosive demolition agent has a Hygienic Certificate HK/B/0392/01/2016 issued by National Institute of Hygiene (Warsaw, Poland).

Similarly to its main constituents (quicklime and cement), it is classified as an irritant. Explosives possession, handling, storage and transportation safety measures are not required. Using the product without complying to the recommendations within this Data Sheet and the Material Safety Data Sheet, or in a different application, than a recommended one can be dangerous for the user. DYNACEM is safe for the environment.

### **Main hazards:**

- in case of non-compliance with instructions for use, the product may suddenly heat up once poured into the hole, release smoke or dry up quickly, which indicates it is on the verge of boiling and the water vapour contained inside may rapidly blow the hole contents out into the air, resulting in body damage, protective goggles damage and vision loss, should one look down a filled hole. This may happen when: DYNACEM type (STANDARD/SUMMER), hole diameter, temperature of mixing water and DYNACEM are not tailored to the temperature of the demolished element and/or the mixture is poured into holes still hot after drilling and/or the mixture starts reacting and heating up in the mixer before being poured into holes, and/or the sun shines on the filled holes,
- in case of non-compliance with instructions for use, the product may start reacting when mixed with water, releasing heat, boiling and splashing hot liquid outside of the mixing vessel, which may lead to burns or serious eye damage. This may happen when the stirrer and the vessel are unclean and the remains of the previous batch enter the fresh one, mixing time is too long, or the items were stored in a warm place,
- product transport, or stirring may generate dust which forms a highly alkaline environment when in contact with sweat, or tears. This may result in skin and mucous membrane irritation, burns and serious eye damage.

### **How to mitigate hazards:**

- download the up-to date version of the Material Safety Data Sheet (MSDS) and the Data Sheet from [www.dynacem.pl/uk](http://www.dynacem.pl/uk),
- assign a capable and responsible person to handle the product. Ensure that they have read the MSDS and the Data Sheet, remember and understand the rules of product handling, safety and personal protection,
- when planning the work, keep in mind that destroying the first element/fragment, may affect the stability of the structure and cause it to collapse,
- ensure there is a high quantity of clean water available on site to wash the skin, or eyes in the event of exposure,
- do not use contact lenses, do use skin protection cream, wash hands before breaks and after work,
- use personal protective equipment marked CE: goggles, chemically resistant gloves, half face dust masks (full face masks for long term work in dusted areas, or in confined spaces), hard hats, and coveralls (long sleeves and legs),
- do not induce dusting,
- adjust the type (STANDARD/SUMMER), hole diameter and mixing water temperature to the demolished element temperature,
- prior to producing a new batch, ensure that the stirrer and the vessel are perfectly clean and free from remains of the previous batch,
- observe the demolition grout during mixing with water. If the mixture starts to heat up, smoke, or dry up rapidly, stop stirring immediately and spread it on the ground,
- never pour the expansive demolition agent into closed receptacles, receptacles with a tapering rim (e.g. bottles) and into holes within wooden elements,



- in the summer, aim to carry out the work away from direct sunlight - early in the morning (best) or in the evening, do not store the materials in the sun, try to use cool water, vessel and agitator,
- ensure that for 12 hours after filling the holes are shielded from sun or rain with a bright coloured tarpaulin and no one comes close and/or directs their eyes upon the holes,
- ensure that no one, under any circumstances (even when wearing PPE including goggles) looks directly into the filled holes,
- store in a dry place.

#### First aid:

- eye contact: rinse eye in running water for several minutes and consult a doctor immediately,
- skin contact: wash the irritated/burnt area with water and soap and rinse thoroughly,
- inhalation: escort the affected personnel from the dusted area (adhere to PPE guidelines and avoid personal injury) and seek medical help,
- ingestion: rinse mouth with water and drink cold, clean water in small portions. Do not induce vomiting and seek medical help immediately.

#### Safety labels:



Wear  
safety goggles



Wear  
a dust mask



Wear  
chemically  
resistant gloves



Never look  
directly into the holes  
filled with the product



Never pour  
into receptacles  
with tapering rim

### PACKAGING AND STORAGE

DYNACEM needs to be stored in a dry place. Shelf life in unopened packaging is minimum 12 months from the purchase date. To significantly extend the shelf life, make a small incision in the DYNACEM bag and vacuum pack. Once a receptacle has been opened it has to be re-sealed. All air must be squeezed out prior to re-sealing and continued storage, as DYNACEM powder tends to absorb moisture and gradually loses potency when exposed to the atmosphere.

Packaging: 5 kg and 20 kg plastic bags and boxes, 30 kg steel buckets for air transport.

### DISCLAIMER

All information presented in this document is based on our best knowledge and experience. It is not, however, binding and does not form any legal or contractual agreement, or additional obligations of purchase contract, and its completeness is not guaranteed. Before using, the user shall determine the suitability of the product for a given application at user's own risk and full responsibility. We are not responsible for any damage, loss, injury and direct, or indirect damage resulting from using or, inability to use our product. We guarantee that products shipped to customers are defect-free. Our obligation under this guarantee shall be limited to replacement of product that proves to be defective, which takes place in accordance with our Sales Regulations. All information and statements beyond the content of this Data Sheet are not, in any way, binding, until confirmed in a written agreement. With the release of this Data Sheet, all previous Data Sheets of this product lose validity. The content of this document is protected by law. Reproducing, copying, modifying, sharing over the internet and transmitting its content (or parts thereof) electronically, or physically in any way is forbidden without a written permission from OTiK Sp. z o. o. in Gdynia. Name and logo of the DYNACEM product are trademarks reserved by OTiK Sp. z o. o. in Gdynia.



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Make sure you download and read the  
current Information Sheet and MSDS  
before you commence work:  
[www.dynacem.pl/uk](http://www.dynacem.pl/uk)

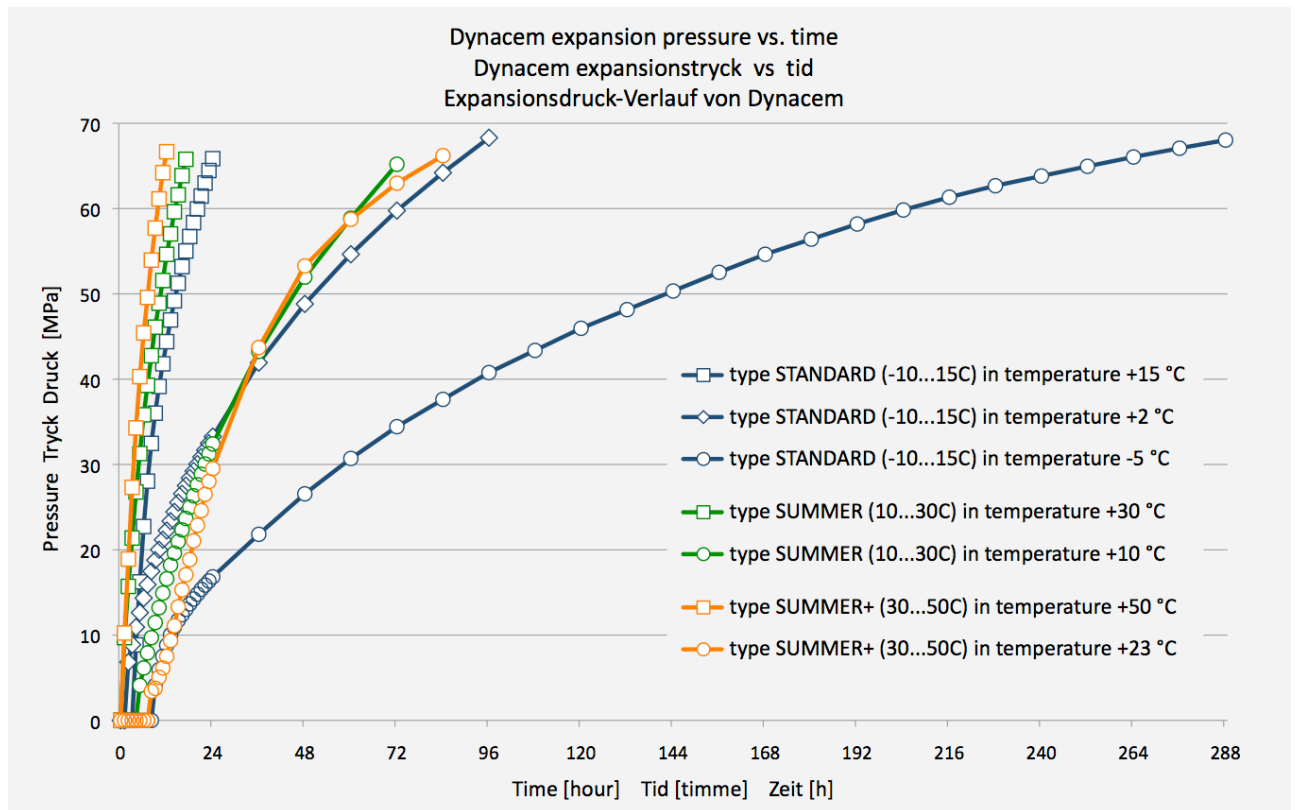


## Appendix to Dynacem Data Sheet.

Dynacem expansion pressure increase vs. time is tested for each produced batch of product before it is qualified for sale. Our aim is to provide to customers the highest available today and measurable quality of the product.

Tests are made in selected temperatures related to Dynacem application temperature ranges. Results of different Dynacem versions are presented on the chart below.

Each performed test has been stopped to protect the equipment against damage, before the pressure has reached: 70 [MPa] (= 700 [Bar] = 7138014 [kg/m<sup>2</sup>] = 10153 [psi]).



## Conclusions

1. Each Dynacem version in each temperature generated a much higher pressure than the tensile strength of concrete, mineral building materials and the hardest stones.
2. Pressure of every tested sample was still growing in the moment the test has been stopped for safety reasons. Significantly higher pressures, far above 70 MPa, can be obtained after a longer period of time.
3. Each version is slower and weaker performing below or at the bottom of its temperature range and is very fast performing at the top of its temperature range.
4. High expansion pressure can be quickly achieved at any temperature (from -10 to +50 ° C) when the correct product version is used.

Gdynia, 14.02.2019



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