

## 3T firefighting

Firefighters who are actively trying to stay informed on new developments in firefighting will raise some eyebrows when reading the title. "3T firefighting?" Shouldn't that be "3D firefighting?" The term 3D firefighting was introduced in the 90's by Paul Grimwood. He wanted to show that firefighting had evolved from a two dimensional environment to a three dimensional one. Techniques such as gas cooling were a result of this. 3D firefighting has led to the fire service adapting to the influence of changing contents in structures.

However this article isn't about 3D firefighting. The "3T" in the title isn't a typo. In June 2014 the International Instructors Workshop (IFIW) gathered in Poland. Several prominent firemen and scientists from around the world gave lectures and discussions were held on both new problems and solutions in the field of firefighting.

Arturo Arnalich, a Spanish chief officer of the fire service of Guadalajara first introduced the concept of 3T-firefighting. The goal of this article is to share knowledge on the subject with the Belgian fire service.

### 1 What is 3T firefighting?

Efficient firefighting consists of several different components. To put out a fire, firefighters need tools. They can also choose from a wide array of techniques (e.g. the long pulse) to tackle the fire. Aside from that, the techniques used have to fit into a tactic.

The moment firefighters arrive on scene, the chief/company officer has the option to choose an offensive strategy. This strategy is subsequently divided into different tactics. One of those tactics is deploying an attack hose line. The attack crew will then advance towards the fire and extinguish it. This action will require the use of several different techniques. It may be that the attack crew will have to start with forcible entry techniques because the front door has to be opened up first. A Halligan tool can facilitate this process. Next, smoke gases can be cooled during the advance. This can be done with either a short pulse or a long pulse, again two different techniques. Finally the fire can be put out with painting and penciling.

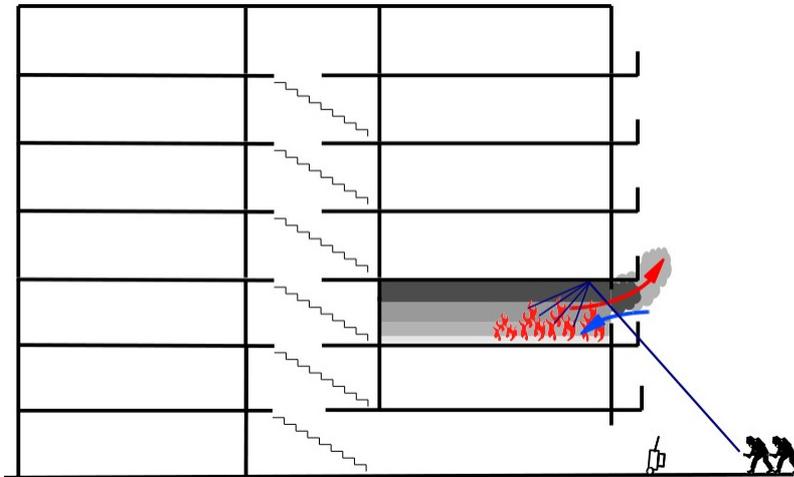


**Figure 1** An apartment fire on the second floor. The window of the living room has broken down. There's an outward flow of smoke (red arrow) and an inward flow of air (blue arrow). (Illustration: Art Arnalich)

Our colleague Arnalich, says that firefighters are always using a 3T combination during firefighting. At the same time one tool, one technique and one tactic are being used. Hence the name "3T firefighting".

## 2 In Belgium?

### 2.1 Everyone uses 3T firefighting



**Figure 2** When executing a transitional attack, an exterior attack is initially used for about ten seconds to reduce the power of the (fully developed) fire. For fires above the ground floor this is done with a solid jet stream. (Illustration: Art Arnalich)

All of the fire services are already using 3T firefighting. After all we all choose a tool (high pressure reel, lay flat hose line Ø 45) to attack the fire. Next we choose a technique. In the past we sometimes chose to flood the fire with water. Luckily gas cooling has found its way into most fire services. This technique allows for a safe way to advance toward the fire through a building. Altogether, this fits into a tactic. Which often is the deployment of a single attack line.

The Brussels Fire Department, where I serve as a career battalion chief, is often faced with fires that can be perfectly tackled using a single high pressure attack line. I estimate about 85-90% of the fires fall into this category. It is also my (immodest) opinion that no one in Belgium is as fast and efficient as Brussels in using a high pressure booster line. This is because a lot of our fires take place in (older) apartments and houses. Most of the time the fire is situated beneath the 6<sup>th</sup> floor so a high pressure attack line remains a valid option.

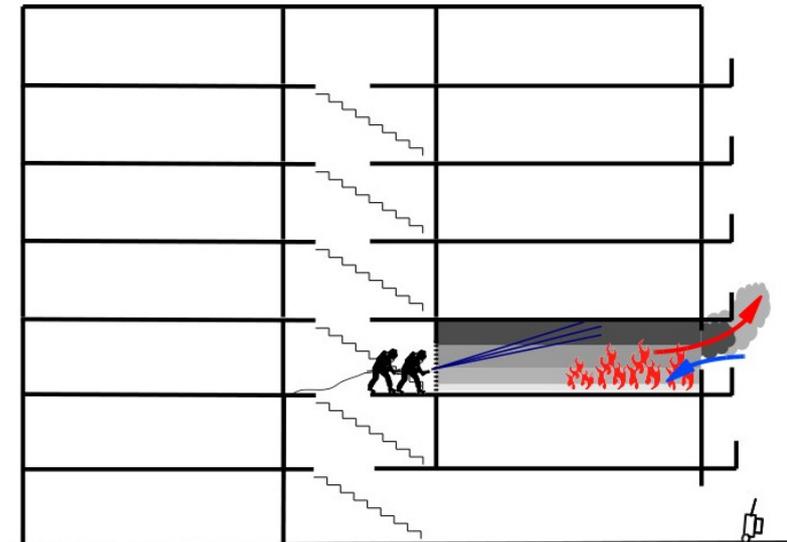
Still there's a flipside to this coin. In Brussels, and also in most other departments in Belgium, more often than not the same combination of 3T is chosen: an interior attack using a high pressure line in which the technique is first gas cooling and eventually a direct attack on the seat of the fire.

### 2.2 What determines the choice?

Up until the mid 2000's practically every department was using a high pressure line for interior attacks. This was partially because the double rolled lay flat hoses in fire engines were very awkward to deploy indoors. During the latter half of the 2000's, coiled attack lines and lay flat lines in cases ("cassettes") were introduced. Cassettes containing hoses folded in a serpentine pattern proved to be viable for deployment inside buildings. In Wallonia the fire service of Moeskroen took a leading role while Jean-Claude Vantorre of the fire service of Knokke-Heist in Flanders introduced and improved the system.

For some years now, the choice of the first "T" (tool) no longer depends on the fact that there's nothing else available for an interior attack.

Yet we still see a lot of firefighters desperately holding on to high pressure lines. Why is this? Well for one, we like to hold on to things that are familiar to us. Even for 3T firefighting, this is the case. We all have a certain combination with which we perform well and get good results. Then because we get good results, we primarily train the specific combination. Also we rarely take a look at how our colleagues are handling matters. When my career first started in Brussels in 2004, the preferred 3T combination was an interior



**Figure 3** The attack crew is performing a door entry procedure at the front door of the apartment. The partly opened door is depicted by a dotted line. (Illustration: Art Arnalich)

attack (tactic) using a single high pressure line (tool). Most of the time a direct attack was used (technique) because gas cooling was not widely known back then. I was very impressed with the speed and professionalism that was displayed while applying this 3T.

However in other countries a very different 3T is selected for the same situation. And just like us, they aren't particularly fond of change. Foreign firefighters have also developed a favourite combination which gets them good results, has them training on a lot and gives them a good feeling about. The interesting part is that a similar situation is handled well in country A as well as in country B, but then with a different 3T combination. And still there's a large reluctance to try someone else's combination.

Art Arnalich poses that we put our favourite 3T combination on a pedestal. We mainly see its advantages and minimize its disadvantages. Subsequently we use our 3T on incidents where it really isn't the best course of action. In Brussels I sometimes come to the conclusion that we started with one high pressure line on a fire scene where we really shouldn't have. So we are also clinging a bit to our preferred 3T and sometimes get caught in situations where it was inadvisable.

### 2.3 Benefits of multiple 3T's

Arnalich advocates the skilful combining of the 3 T's. This can be compared to a musician. A musician will also switch from fast to slow and loud to quiet. Only by putting variation into his music, he'll create a beautiful composition.

It's the same in firefighting. As we're able to put more variation into our choice of the three T's, we'll be able to handle more various incidents.

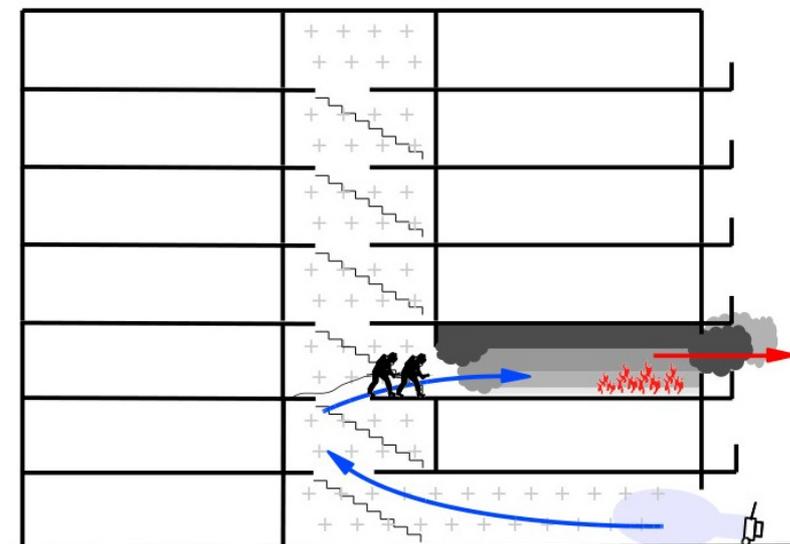
In Belgium we have already gone through some evolution concerning the choice of variation. As illustrated above, a lot of services already can choose between high pressure and low pressure attack coils. So there is variation possible in the tools. Next to that the interior attack is executed in many services by first using gas cooling as a technique, then

pulsing-pencilling is used and finally the fire is finished with painting. Tactically however, there hasn't been much variation.

### 3 Why is variation so important?

The question can now be asked as to why it's so important for the fire service to be able to vary. Why can we not solve everything with our favourite 3T combination? Well, the answer to that question is found by looking at fire behaviour.

A fire of a 100 years ago is very different from a fire nowadays. Because of a change of contents, a fire is progressing more rapidly than it used to. The time until flashover has been shortened from 30 minutes in the 50's to 3 minutes now. There's also a lot more smoke being produced than before and the smoke is more flammable than it was in the past. The introduction of 3D-firefighting brought an answer to these problems. Especially the different new nozzle techniques meant a leap forwards for the fire service.

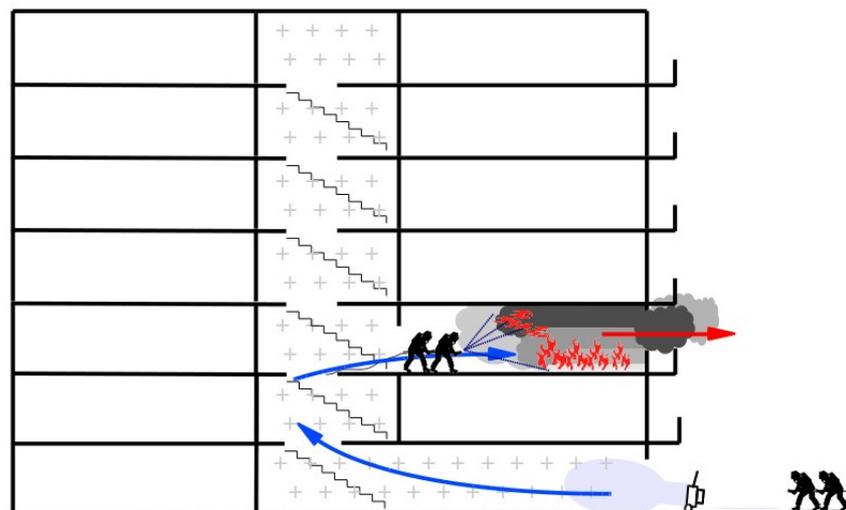


**Figure 4** The attack crew fully opens the front door (the dotted line is gone). The tactic is shifted to a positive pressure attack. The fan is creating a flow from the stairwell through the apartment into the outside. An over pressure is formed in the stairwell that will protect against smoke spread. (Illustration: Art Arnalich)

Because of changes in building methods we now have under ventilated fires. These kind of fires will not restart their progress until a fire crew opens the door in order to extinguish it. After the door has been opened, the fire progresses very rapidly into ventilation induced flashover.

Both of the fires illustrated above are fundamentally different. The first kind, the ventilated fire progress, is just a faster version of the fire that has always existed. Our favourite 3T combination is therefore a good answer to this particular problem on the

condition that gas cooling is used during the advance towards the fire. However it will frequently go badly when we use our favourite 3T combination for an under ventilated fire. This will demand a different approach. All around the world firefighters are trying to find a good 3T for under ventilated fires.



**Figure 5** The crew is executing an interior attack. The techniques used are gas cooling (short and long pulse) and direct attack (penciling or painting). The support of ventilation allows them to swiftly locate and knock down the fire. (Illustration: Art Arnalich)

Changing construction methods have also caused an increasing number of fires that are “inside the walls” or “in the roof”. Such a fire doesn’t behave like a ventilated fire. Nor does it behave like an under ventilated fire. Often it is a fire burning inside the building’s structure. The fire is progressing slowly because there’s little to no air able to reach it. In Sweden, such a fire is called a “construction fire”. The construction itself is on fire. This type of fire is opposite to the

“contents fire”.

Handling a construction fire will again demand one or more 3T’s.

Above we illustrated three fundamentally different types of fires. Two of those three are relatively new phenomena. Fundamentally different problems require fundamentally different solutions. That’s why it’s important for the fire service to be flexible and to be able to skillfully produce different combinations.

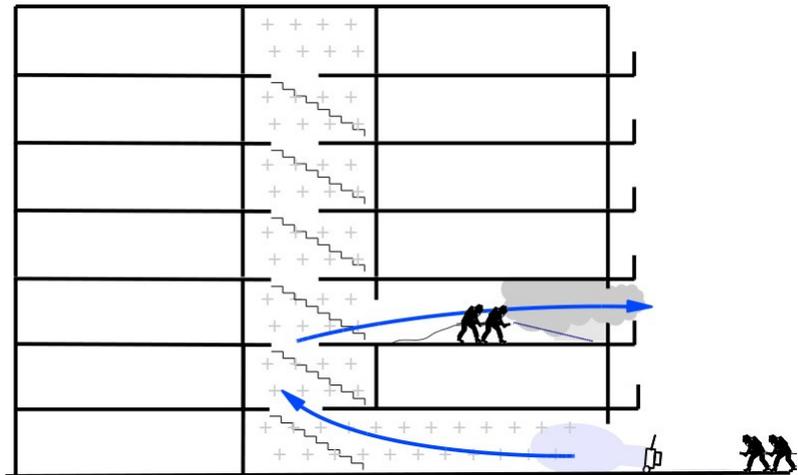
## 4 What is needed for producing good combinations?

### 4.1 For chief officers and company officers

Actually, quite a lot is needed to reach a good application of 3T’s. An officer needs to understand the problem in order to choose a 3T that’s ideal for the situation. It’s therefore imperative that a good size up is performed first. Next the officer needs to analyze the elements from the size-up and, based on these, make a decision.

That’s why it’s extremely important for those people to have adequate knowledge on fire behavior (the problem) and on tools, techniques and tactics (the solution). Also the size-up is dynamic in nature. Fire is always progressing. The commanding officer needs to check the situation regularly and has to evaluate any changes. If necessary, he can alter the 3T combination(s) that is (are) being used on the fire ground in order to ensure both safety and efficiency.

Good command abilities are a final necessity for IC's. During firefighting, crews often face practical difficulties. These can lead to certain assignments being poorly or badly executed, or sometimes not at all. It's the responsibility of the officers to make sure all assignments are carried out. If needed, extra crews may have to be assigned. Another possibility is that certain tasks are being delayed because of problems



**Figure 6** The fire has been put out. Overhaul is started. PPV takes care of the remaining smoke. (Illustration: Art Arnalich)

arising. Commanding officers need to be able to handle these situations skillfully. When certain tasks are influencing each other (e.g. setting up ventilation and deploying an attack line), the officers in charge need to make sure that the different crews are coordinated. An example: If the attack crew is advancing very slowly, the ventilation crew needs to take this into account. That means starting up the fan may have to be postponed until the attack crew is ready.

#### 4.2 For firefighters

Firefighters also need to meet certain requirements to be able to skillfully apply the 3T's. First of all, everyone (including commanding officers) needs to familiarize themselves with all the different tools and their workings and also the different techniques with their pros and cons. Finally they also need to know the different tactics. It's important as well for them to know when certain tactics are okay to use and when some tactics are inadvisable. The more knowledge they possess on the three T's, the better they'll understand what the commanding officer is trying to achieve. To reach this level of knowledge, the fire service will have to provide sufficient education and training.

Finally it's important that everyone realises that "firefighting" is a team effort. A chief officer is nothing without his company officers and crews. Only by cooperation will we be able to get good results. With good anticipation and team chemistry, crews will perform more skillfully during interventions. By training adequately, different 3T's will be produced more smoothly.

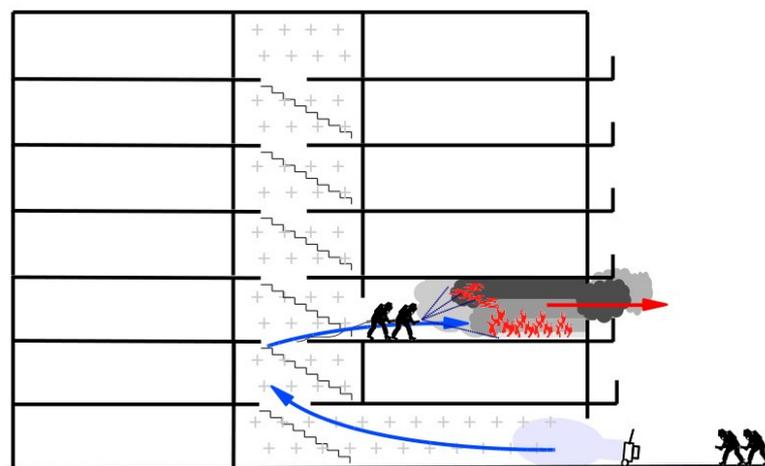
### 5 An example: Combined Fire attack

During his lecture at IFIW 2014, Art Arnalich provided an example of good 3T firefighting. He named it "Combined Fire Attack". He describes the scenario of an apartment fire on the second floor (see Figure 1). In a case like that he'll opt for a transitional attack. The technique he uses is a solid jet stream against the ceiling **for about ten seconds** (see Figure 2). The tool is a low pressure hose line so a large flow can be used. The goal is to reduce the heat release rate of the fire. This exterior attack can even be executed with a

hose line directly connected to the fire engine's pressure side (with a diameter reduction 70/45).

As soon as the fire's been knocked down, an interior attack can be initiated. The attack crew will advance to the second floor and perform a door entry procedure to gain a safe access into the compartment (see Figure 3). A door entry procedure is a tactic in which several different techniques (operating the door, preventively gas cooling outside the door, gas cooling inside the door, observing the situation, ...) are combined.

The fire service of Guadalajara uses a lot of PPV. At this stage of the extinguishment, their tactic will shift again. From this point they'll apply positive pressure attack (PPA). At the bottom of the stairwell a fan is set up. The fan is started the moment the attack crew fully opens the door (see Figure 4). If there's a lot of smoke in the stairwell, a smoke vent will also be opened. Two flows will then form. Both will start below at the fan. They will follow the hallway and go up in the stairwell. One will flow throughout the entire stairwell and exit the building at the smoke vent. This will cause the stairwell to be 'flushed'. The moment the stairwell has been cleared of smoke, the smoke vent can be closed again. An overpressure is formed inside the stairwell that will protect the other apartments. Figure 4 illustrates this with plus signs.



**Figure 7** Combination of exterior and interior attack. The PPV forces the steam produced by the exterior attack outwards. That way it is no longer a threat to the attack crew. (Illustration: Art Arnalich)

The second flow cuts through the apartment. This flow will cause the attack crew to have the wind at their backs. The flow will cause a large amount of smoke to be exited from the apartment and will improve visibility. Since the operation started with a transitional attack, the fire will need time to regain intensity. This would be completely different if the fan had been started without performing an exterior attack first.

After a large part of the smoke has been cleared from the inside, the attack crew initiates an interior attack (see Figure 5). Within the whole of the tactic PPA, ventilation is now combined with several different nozzle techniques. First gases will be cooled during the advance. Depending on the fire conditions this will be done with short or long pulses. As soon as the seat of the fire has been found, the crew will start extinguishment. This can be done with penciling or painting depending on the size of the fire. If necessary, these two techniques can be combined with gas cooling. Two different tools are used by two different crews in this scenario. Downstairs there's a fan set up, while upstairs there's a crew handling a hose line.

The moment the fire's been put out, overhaul can be started (see Figure 6). The fan at the bottom stays on to clear the remaining smoke from the apartment. This will create a safe work environment for the firefighters.

Art also mentioned that his crew outside will repeat the exterior attack should the fire flare up again before the interior crew can get to it (see Figure 7). In their experience the fan negates any danger from the steam caused by the exterior attack. This may be a bridge too far for the Belgian fire service. It's probably better to first build up experience and expertise with the transitional attack and add PPV to it later.

## 6 Bibliography

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- [3] *Combined Fire Attack*, Art Arnalich, article to be published in *Fire Engineering magazine*.
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