Section for Detonation and Combustion, SDF
The Swedish Section for Detonics and Combustion,
affiliated with The Combustion Institute
www.sdfsweden.se/default.sv.php info@sdfsweden.se

SDF Newsletter 2022:1

SDF is a non-profit association with the aim of bringing together people in the science and technology fields of detonics and combustion for information exchange and cooperation. Membership is free, but the association will gladly accept voluntary contributions, small and large, to Plusgiro 196 69 42-3.

Chairman Ola Listh has the floor

Welcome back to an exciting autumn with SDF. After a long period of silence, partly due to the death of our very active secretary Stig Johansson, partly due to the pandemic, we restarted with some activities in the spring. Three lectures via Zoom were carried out and our new secretary Håkan Ljunqvist is the one who through intensive work managed to make these happen.

As you know, the SDF forms *the Swedish Section* within the international organization of *the Combustion Institute.* The institute conducts its *Combustion Symposium* every two years and this summer it was time again, this time in Vancouver, Canada. Our board member Assistant Professor Alexis Bohlin, in Propulsion and diagnostics at Luleå University of Technology in Kiruna, had the great honor to present his scientific contribution *"Water vapor in hydrogen flames measured by time-resolved collisional dephasing of the pure- rotational Nÿ CARS signal"* at the conference. Alexis thus also represented us at the conference, more on that elsewhere.

Over the summer the chairman and secretary have spent a lot of time trying to update our membership register and bring it in line with that of the *Combustion Institute.* From 74 last year, the number of members has now increased to 281. SDF's finances could be better. Since we have so far not charged any membership fee, our funds are decreasing. *Members and companies are therefore welcomed to sponsor our activities.*

Furthermore, we have now brought home the large SDF material that was collected by our former secretary. It will now be deposited at the Explosives Museum in Zakrisdal. We have also offered to take care of a large part of the scientific library, mostly in chemistry, which Stig collected during fifty years of work.

The secretary has continued to put a lot of work into organizing interesting activities and we can look forward to three more lectures via Zoom in the autumn and possibly also a study visit.

Finally, I would like to remind you that we will have our annual meeting in the first quarter of 2023 and that we currently have no nomination committee to propose a new board. Please register as a member in the nomination committee or at least advise the board of suitable people to recruit to the nomination committee.

Program 2022-2023 http://www.sdfsweden.se/history/default.sv.php
Lectures:

• Thursday 2022-10-20 at 19.30 Zoom: History and Technology of the 84 mm recoilless rifle
Leif Jilsmo and Nils Örnebring

• Thursday 2022-11-17 at 19.30 Zoom: PICs (Products of Incomplete Combustion) Elna Heimdal Nilsson

Study visits that the SDF is working on implementing, at some point in the future:

• The Sprängtekniska Museum, underground facility Zakrisdal and the Brigade Museum, Karlstad
• FOA shock wave tube IV and the Swedish Armed Forces' dog service unit (FHTE), Märsta
• The Hanssons Pyrotekniska AB, Lindesberg, and Orica, Gyttorp
• Kiruna, with a visit to Esrange, LKAB's tourist mine and Kimit (?)
• Epc-Group at Hugelsta shooting range, Cesium AB, Vingåkersverken
• FOI, Grindsjön
• ??? Your company/Institution ?

Travelogue from 39th International Symposium on Combustion in Vancouver, Canada, 2022-07-24--29, by Assistant Professor Alexis Bohlin

The Combustion Symposium takes place every two years and was organized in Vancouver at this time. I travelled there together with a PhD student to present our research project which had been accepted as part of the oral program. In order for a paper to be accepted for presentation, it must undergo a review by at least 3 experts and receive high marks in order to stand up to the competition among the other submissions. That we were accepted for oral presentation is a great success. Many, up to a third, who had intended to participate in the conference this year had not received entry visas to Canada, which is why there was a rather large drop in participants compared to previous years.

The new findings we presented were a new method to be able to measure concentrations of water vapor in hydrogen flames. We received a very good response and it felt like we had reason to be satisfied. We also presntes two posters the following day. The atmosphere at the posters is less formal and you have the chance to discuss the results in more detail with your colleagues. My favorite is actually poster presentations, just because it becomes more of a two-way communication instead of a one-way communication in an oral presentation. On the other hand, to experience a skillful oral presentation I think is one of the real highlights you can be part of as a scientist.

This year, we as Swedes had the opportunity to feel really proud at the Combustion Symposium, when the main invited lecture - the Hottel Lecture - was given by Professor Marcus Aldén from Lund University. And what a lecture he delivered. Marcus summarized his outstanding career in the development of laser diagnostics to measure combustion processes. There are different techniques and Marcus and colleagues in Lund have developed truly unique and ingenious inventions within all of these. Most of the research with advanced laser measurement methods takes place in a laboratory environment where the boundary conditions for the experiments can be controlled. The results from diagnostic work are then used by modellers both for fluid calculations and for chemical kinematics. He also spoke about the application of laser diagnostics in Swedish industry, for which he has become world-renowned, within a range of everything from heating plants, gas turbines to cars and jet engines. *Really good job, Marcus!*

The last thing I would like to report on is the discussion during this year's conference about the difficulty you sometimes face as a combustion researcher in being able to clearly communicate the importance of your work. It was particularly aimed at young

researchers who have a chance to choose a career and an area of expertise, and may be wondering why one should pursue studies in combustion if it becomes more difficult to obtain research grants and thus almost impossible to develop one's professional skills in the field.

A few years ago, most research in combustion was about how to reduce emissions of NOx (nitrogen mono- and dioxides), while today it is about how to reduce emissions of carbon dioxide. When burning fossil fuels, there is a net increase in carbon dioxide in the atmosphere. In Kiruna, where I live, we have proposed a series of measures to reduce the input of carbon dioxide into the atmosphere. LKAB with partners (SSAB and Vattenfall) will start producing carbon dioxide-free steel, and out at Esrange space base with the Swedish Space Corporation (SSC) we focus on sustainable access to space. This work also includes a change to more renewable fuel during rocket launches, both for sounding rockets used for scientific research and larger launch vehicles that will put satellites into orbit. It is exciting and there's a lot to do.

Alexis Bohlin is an Assistant Professor in Propulsion and Diagnostics at the Luleå University of Technology, as well as a board member of the Section for Detonics and Combustion

Gunpowder and explosives in combat aircraft rescue systems

Lecture by Mr. Georg Ohlsson, M.Sc.Eng., for SDF via Zoom 2022-09-29

Rescue systems are the most peaceful part of a fighter plane because they are there to save lives. Good rescue systems in which the pilot has confidence are tactically important so that he/she can make full use of the aircraft's performance.

The primary component of modern rescue systems is the catapult seat. The task of it during flight is to provide an adjustable, fixed and comfortable seat for the pilot. Furthermore, oxygen is provided for breathing, air for ventilation and pressurization as well as the transmission of telephony. In the event of an emergency, he/she will be rescued by an automatic sequence after manual activation.

Explosives store energy easily and cheaply to be able to later do work in a mechanism or as the propellant of a rocket. They contain their own oxidizer. Gunpowder differs from explosives by a significantly lower burning rate. A mechanically or electrically activated ignition kit is required for ignition.

The energy will be extracted in an exothermal reaction by trapping the combustion gases in a mechanism of some kind or releasing them through rocket nozzles. Solid gunpowder is used in rescue systems. Safety is handled by an appropriate design. Gunpowder is somewhat chemically unstable, which leads to limited shelf life.

The Saab Co., at Linköping, has a long tradition of developing rescue systems of military aircraft since 1939. The motive was aircraft 21 (J 21) which was driven by a propeller behind the cabin. It was realized early on that you had to be able to eject the pilot with a catapult chair over the propeller field. Compressed air operation was unsuitable for several reasons, which is why gunpowder technology was chosen. This seat was available in four different aircraft types. A total of 23 people were rescued in the period up to 1954.

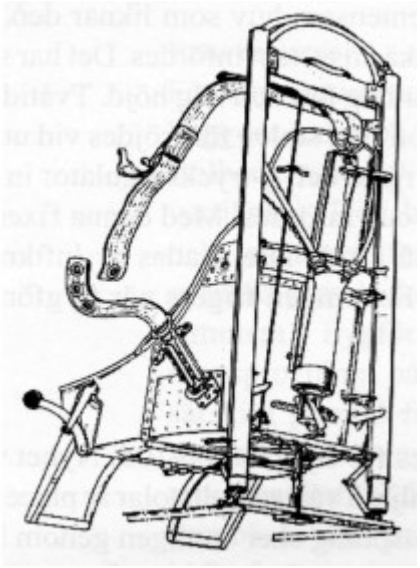


Image of Saab's last catapult seat with pilot for Image of Saab' first catapult seat for aircraft 37 Viggen, shortly after emergency the Saab 21 launch. The arm restraint nets and leg fixation supports are clearly visible. High speed testing was conducted at supersonic speeds in New Mexico USA.

Saab's seat development was finished in 1980. About 330 pilots have been saved with seven different seat types from eight different aircraft types.

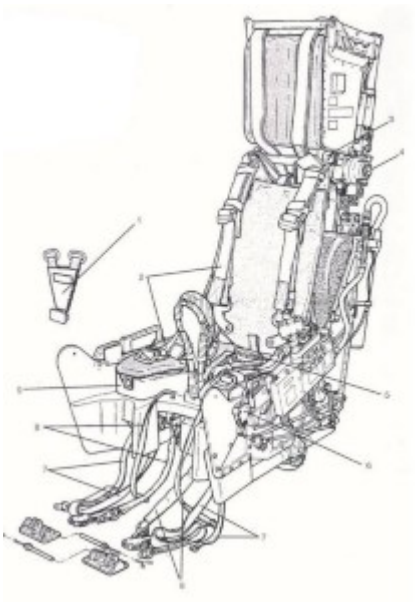


Image of the Martin Baker catapult seat for the Saab 39 ”Gripen”.

The Martin Baker company, based in London, started with chair development in 1946 and is now a world leader.

A modern catapult chair consists of a fixed part with a cannon and an adjustable seat tub. A powder rocket engine is located under the chair. The chair has a combined tether and parachute harness, restraints, parachutes and emergency kit, and ejection

handles. Furthermore, there is an oxygen and g-pressure regulator as well as connections for electricity and supplies to the pilot. The emergency equipment includes, among other, a lifeboat.

The rescue system also includes an advanced flight suit with boots, g-pants, fixations, insulation layer, ventilation, chest bladder and gloves. It also has an automatic life jacket, emergency transmitter and helmet. The helmet has a visor, breathing mask and telephony.

Before take-off, the pilot must manually connect leg restraints, lifeboat line, harness, arm restraints, breathing gas, g- suit pressure, ventilation and telephony. After landing, he/she must disconnect these in reverse order.

The catapult chair contains several devices with different functions where gunpowder gases perform work. Signal transmission to these and activation usually take place with gunpowder gas pressure.

Powder cartridges are usually found outside the chair, also for inflating the life jacket and lifeboat. Saab's rescue system also has powder cartridges in parachute triggers and in some time triggers.

When emergency ejection is activated with the ejection handle, a primary powder cartridge is ignited. Gunpowder gases from this activate hood blasting and chair cannon. The gun's propellant cartridge pressurizes the gun so that it is ejected obliquely upwards/rearwards along aircraft fixed guides, with physiologically tolerable acceleration.

The rocket engine will ignite and increase its speed outward to ensure that the chair passes freely over the plane's fin. It also permits a successful rescue can also take place from a stationary aircraft on the ground but constitutes a disadvantage if emergency ejection takes place towards the ground in an inverted position.

Modern chairs exist that have two cannons and electrical or explosive-based signalling systems. Another powder cartridge ignites and supplies propellant gases to a screen extractor which ejects a projectile weight obliquely upwards/rearwards. The impulse of this throw weight pulls out a stabilizer screen behind the seat. The movements of the catapult chair are then stabilized so that high deceleration forces in inappropriate directions will be avoided.

A release mechanism will be activated but delayed at high altitude and at high speed. When certain conditions are met, a powder cartridge will be ignited, the powder gases of which operate the mechanism that disengages the pilot, the stabilizer parachute and the main parachute from the seat. The stabilizer screen pulls the main parachute out of its container.

The main parachute deploys and slows the pilot down to a suitably low landing speed.

For two-seater aircraft with tandem cabins, the rear seat is activated first, regardless of who activated the rescue sequence.

The front seat will be delayed for half a second, using a pyrotechnic delay.

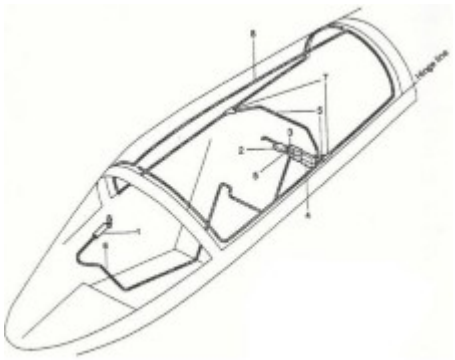
Before the seat can be launched, the cabin hood or at least its glass needs to be removed.

The most common method is for the cabin hood to be folded back around a hinge by means of gunpowder gas-powered hood launchers in the rail, or rockets on the hood frame, with the help of external aerodynamic lift forces.

For the aircraft 39 Gripen, a unique hood blast system was developed for the hood glass. A linear lead-encapsulated explosive charge of hexanitrostilbene (HNS) is glued via a plastic strip to the inside of the glass along the hood frame and centrally. The

system will be activated by gunpowder gas pressure from the seat through explosive-based ignition lines to the left and right sides of the hood.

The hood glass will split symmetrically into two parts under the influence of the blast impulse, internal cabin overpressure and external air drag forces. The process occurs so fast that the glass parts do not collide with the chair.



For quick exit, there is a mechanical detonator in the cabin, the signal of which is transmitted by ignition wires to the explosive charge. The hood blast system is secured when the hood is open.

This system is duplicated for two-seater aircraft. For the rear part of the hood, the effect is enhanced by an electrically activated airbag in front of the pilot.

Gunpowder for Saab's rescue system was developed by Bofors at Karlskoga, Nitro Nobel at Nora and the Åker's Krutbruk at Åkers Styckebruk. Martin Baker develops its own powder charges and rocket engines. The hood blast system parts are supplied by Mc Cormick Selph in Ca., USA and for the rear cabin also by the Autoliv AB at Vårgårda.

Sweden was isolated during the Second World War, which is why Saab had to rely on its own resources. After the war it emerged that in Germany several companies developed rescue systems for their own aircraft. Reportedly, 60 pilots were rescued during the war years. No other country had, as far as is known, been a pioneer in this field.

Later it turned out that the Zvezda Co. in Moscow has developed very advanced rescue systems for Russian aircraft. This was presented at a conference in Las Vegas, USA, in 1979. The seat type Zvezda K36 saved the pilots at a crash in Paris with a Russian aircraft.

Mc Donnel Douglas in the USA developed ejection seats for the GD F16 aircraft.

Knowledge of the use of gunpowder and explosives is important when developing rescue systems. Other important areas are calculation methods, ergonomics, aerodynamics and parachute technology as well as, in recent years, also electronics.

Georg Ohlsson holds a M.Sc. in Aeronautical Engineering from the KTH in Stockholm but is now retired. He has extensive experience in development and testing of rescue systems for several different aircraft types at Saab in Linköping. For the aircraft 39 Gripen, he was systems manager for oxygen and rescue systems.

PEACE TECHNOLOGY, an idea for sustainable World Peace and successful businesses

What is Peace Technology?

- It is technology for civil action that can help remove obstacles and facilitate the return to or establishment of a normally functioning, peaceful society.

- A contribution to security policy to promote World peace and labour market policies that may create jobs in Swedish and other export industries. Also useful for disaster relief!
- A new and important, innovative niche area that can bring great success to exports of goods and services while also contributing practically to the UN's work on disarmament and peace-promoting work, such as SaferGuard and the IATG.
- We have seen the terms Military Technology, War Technology and Defence Technology! Today it is all too clear that the most important goal is not to win a war but to conquer a lasting peace and to facilitate the return to normal conditions in troubled, affected countries and areas.

Examples of Peace Technology areas

- Technical systems and equipment for democratic development,
- Communication, reporting, reconnaissance and surveillance, administrative systems,
- Maintenance and repair of critical infrastructure and other buildings,
- Rapidly built housing and other premises,
- Protective equipment for people and buildings,
- Humanitarian clearance (Demining) of land-, sea mines and minefields,
- Detection, collection, safe storage, protection and destruction of weapons, munitions and explosives, UXO (unexploded ordnance), ammunition stores and dumps, including chemical munitions and substances, and their environmentally safe destruction

Why?

- Peace on earth must be our ultimate goal! Today we use far too many resources on military, war and defense technologies and may forget that the main goal is peace!
- Alfred Nobel realised that a Peace Prize was needed! These technologies are needed!

Further reading, and contact!

Janzon B, 2015: Translation from The Royal Swedish Academy of Military Sciences, Transactions and Journal (KKrVA Handlingar och Tidskrift), 218(2015)4 pp 82-105, https://kkrva.se/peace-technology

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The 2022 Board of the Section for Detonics and Combustion, SDF

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