NOTES

Training MODERN VEHICLE TECHNOLOGY

Quick and safe release of people from crashed vehicles.













Explanation of the topics to be covered.

1. Safety systems









1. Safety systems

2. Deactivate









1. Safety systems

2. Deactivate

3. Bodywork reinforcements









1. Safety systems

- 2. Deactivate
- 3. Bodywork reinforcements
- 4. Alternative propulsion









1. Safety systems

- 2. Deactivate
- 3. Bodywork reinforcements
- 4. Alternative propulsion
- 5. Using the Crash Recovery S





System





- Which active safety systems can participants name?
- Active safety systems are activated when the vehicle is started and remain active as long as the vehicle is switched on.
- Active safety systems include ABS, stability control, side-line protection, adaptive cruise control. The active safety systems are designed to prevent accidents.
- What passive safety systems can participants name?
- Passive safety systems include airbags, belt tensioners, body reinforcements. All actions start in the vehicle (belt is tightened slightly (pre-crash, seat upright, close windows, close skylight) when additional braking is applied.
- Passive safety systems are activated in the event of an accident. By switching on the ignition, these systems will also be on standby.

• In a modern vehicle, the active and passive systems are linked; we call this the integrated safety concept.



Passive and active safety systems together form the integrated safety concept.

ACTIVE SAFETY





Visual and audible warning















TED SAFETY CONCEPT



Extra (additional) brakes Reduced





Different names:

- Adaptive Cruise Control
- Anti-collision warning
- Auto pilot
- Active brake assist or city safety (Volvo)







SAFET SYSTEMS



- and work together:
- of ABS, the brakes are activated. (active system).
- a limited number of models.
- Windows and/or the sunroof will close.
- In the event of an accident, the airbags will also be activated.



Integrated safety concept, the active and passive safety systems are coordinated

• Illustration: when a vehicle detects that an accident may occur (e.g. running off the road due to excessive speed), it activates the stability control system and, by means

• When the vehicle detects an imminent accident, the electric seatbelts will tighten slightly (pre-crash) and the occupants will be drawn towards the seat, at the right place for the airbags. When there is a collision (frontal), the belt pretensioners are tightened and airbags are released. These pre-crash belt pretensioners are only on

The seats are placed in the most favourable position possible to prevent injuries.



SAFETY SYSTEMS



The Mercedes-Benz has even more innovative safety systems. For example, this vehicle has an extinguisher system. The extinguishing system is installed in the engine compartment. The Mercedes Inerting System prevents an explosive fire propagation. The reason Mercedes-Benz developed the system is the presence of refrigerant R1234YF in the A/C system. R1234YF gas is highly inflammable and could escape after an accident due to damage to the air conditioning system, causing it to ignite with an explosion because of the heat from the engine and exhaust.

CAUTION! Combustion of R1234YF produces caustic and toxic smoke consisting mainly of hydrofluoric acid. R1234YF ignition can be recognised by a bright flash of light.

Figure 1: Mercedes-Benz Inerting System 1. Gas generator 2. Pipework 3. Atomiser R12/69 is a pyrotechnic charge.

Figure 2: Pipe from behind the mudguard

The gas generator is filled with Argon, an inert, liquefied, cryogenic gas with an asphyxiating effect (displaces oxygen). The system is activated by the SRS (Supplemental Restraint System). In the event of an accident, the SRS will activate the pyrotechnic charge, allowing the gas to flow into the gas generator. This happens under high pressure. The gas in the engine compartment is released through the piping and the atomiser and expels the oxygen, which prevents the refrigerant from igniting. CAUTION! A leak of argon gas can cause burns on bare skin and tightness of the chest. CAUTION! The gas generator in the Inerting System in the CLS is situated behind the right mudguard. By clicking on the gas generator, the first responder is given important information about this gas generator.

Figure 3: Mercedes-Benz CLS 4dr Coupe 2018 Using rescue equipment to create space in this position can lead to a dangerous situation. It is not possible to see if the generator has been activated.

Figure 4: Position of the gas generator for the CLS Class Inerting System The SRS (Supplemental Restraint System) activates the Inerting System in the event of an accident, simultaneously with other passive safety systems such as airbags.









Figure:

- 1. The situation before an impact
- 2. The impact, two belt tensioners are activated in the seat and the steering wheel airbag deploys. The driver is placed directly in front of his steering wheel airbag.
- 3. The driver moves towards the steering wheel airbag. The seat belt retractor gives some play on the belt to avoid injury from the belt itself and to give room for landing in the steering wheel airbag.
- 4. The airbag also deflates immediately to prevent injury and ejection. The anti-submarine airbag in the seat prevents the driver from sliding under the seatbelt, pushing up the knees and keeping them out of the dashboard.

Ask participants how many belt tensioners there can be per seat?

There can be three of these.

- 1. Automatic roll-up, often in the B-pillar.
- 2. Hip belt tensioner on the left-hand side, in the seat, bodywork or B-pillar. 3. Belt lock buckle on the right side, in the seat or in the body.

Ask participants how to find out which belt tensioner the vehicle in question has? Of course you will find this in the CRS.







- 30-60-90 rule
- With your backside on a seat and y you are always safe in the vehicle.





• With your backside on a seat and your back against a backrest, as a rescue worker









INTEGRATED SAFETY CONCEPT





30 cm fr



om side/curtain airbags





INTEGRATED SAFETY CONCEPT





60 ci



m from driver airbag





INTEGRATED SAFETY CONCE





90 cm 1



rom passenger airbag





Drive and fuel systems have built-in safety devices, which are explained in the following slides.











Fuel tank installed in the safest possible place. Behind the rear axle and between the wheels, possibly protected by bodywork reinforcement. INSTALL SAFELY Battery packs and gas cylinders are also installed here.

Fuel pumps are sometimes switched off in an accident, either by the SRS control unit, or sometimes an inertia switch.







SAFETY SYSTEMS

CRASH Recovery System[®]

CONTROLLED BY THE VEHICLE ITSELF:

- Shut down propulsion system
- Unlock doors | Grant access
- Turn on hazard lights | Warn o
- Turn on interior lighting | Impr
- Automatic notification (eCall)





, fuel or power | **Reduce dangers**

thers ove orientation | Call for help



Deactivation means that the vehicle is de-energised, this applies to the drive unit and the 12 V battery.





- All safety systems are supplied with 12 V when the ignition is switched on.
- In the event of an accident, these systems are controlled by the SRS (Supplemental Restraint System) control unit.
- This SRS control unit is located on the tunnel. Somewhere near the radio and the handbrake, in some cases under the back seat (BMW 3 series around 2005) and with some H2 vehicles there is even a second SRS control unit in the vehicle for the H2 installation.



SRS (Supplemental Restraint System) control unit





- Convertible, no roof, curtain airbag in the door.
- collision.
- Optional 48-volt battery system available.
- Reinforcement of the A-pillar with a boron steel pipe.
- Pedestrian safety system at the bonnet hinges.
- AdBlue Tank for diesel engines.





 Rear roll-over protection system, activated in the event of a rear-end collision and in the event of the vehicle being overturned. Is not activated in a frontal



- cartridges.











After deactivation, the HV part is de-energised, but not the 12V system.

After switching off the 12 V systems, objects outlined in red continue to pose a risk: two-stage airbags, pyrotechnic belt pretensioners (cut in) and gas







First show the film and ask what is happening here and the cause.

- The vehicle is NOT de-energised, see the indicators.
- disappeared.





 If a vehicle is not (yet) de-energised, the 30-60-90 distance rule applies until it is de-energised, and the residual voltage (see relevant vehicle in the CRS) has





explosive force.

So use the CRS to determine the cutting locations!





Here you can see why we have made the symbols red: this cartridge contains 250 to 600 bar pressure and when it is cut, the end flies dangerously far away with an



- Different materials are used in the construction of a car.
- From plastic to very hardened steel (boron).
- A,B,C and the sill can be made of this type of steel.
- Can also be made of carbon.
- These body reinforcements are shown in the CRS.
- Boron steel cannot be cut.



- Different colours indicate different types of materials.
- Reinforcements in the pillars can be made of Boron steel or carbon.
- Cutting these pillars will be very difficult and takes a lot of time.
- Correct cutting or tearing technique is necessary when a section has to be removed. For plastics, think of occupational hygiene (carbon).



Different colours indicate different types of materials







- Same vehicle but as a CRS image.
- It is easy to see where the reinforcements are located.











- ripped.
- airbag cartridges right in the back of the car roof).



 Bodywork reinforcements can have both disadvantages and advantages for the response. Sturdier parts can also be used as support points, or they can be

• When choosing to tunnel through the rear, or by unzipping the roof, it is essential to see what you are up against (after all, there are several cars with



- Here, too, all passive safety systems on the side of the vehicle.
- Tunnelling very good option.
- manually.





For this type of vehicle, check whether the rear seats cannot be removed





- All common types of drives.
- Combustion engine + electric motor is a hybrid.
- Some types are combinations of two fuels (bi-fuel).



- All common types of drives.
- combusted in a Ottomotor is hardly used at the moment.
- Hybrid includes: mild hybrid, full hybrid and PHEV.







Under combustion engine stands hydrogen, although this form of hydrogen











Hybrid propulsion









Hybrid propulsion



Ask the participants, what is the difference in risks between an electric or a hybrid car?





Actually, the differences are not that great, unless one considers the fuel tank.









Never touch open components or orange cables!



ALTERNATIVE PROPULSION









What is the difference between a 12 V circuit and an HV circuit?

The 12 V circuit has a ground cable from the battery to the body and the -minus pole flows back to the battery through the metal of the vehicle. The car body is thus part of the 12V circuit.

The HV circuit is completely separate from the bodywork, so it is galvanically separated. The body is NOT part of the HV circuit. That means that if you touch the vehicle, you basically CANNOT be electrocuted. If an HV cable is damaged and touches the body, both HV relays on the HV battery open. If two HV cables are damaged and touch, the HV relays on the battery will also switch off.

Only if part of the HV system is exposed would there be a very small chance of becoming electrocuted, but then you would have to know exactly how to touch the plus and minus poles at the same time. When working on a damaged vehicle, first deactivate it according to the CRS and work with protective clothing, a face shield and 100 V gloves.

What is the difference between a 12 V circuit and an HV circuit?





The HV interlock system is a 12-volt wire that is processed over all plugs and HV components. Sometimes visible on the outside of plugs, sometimes incorporated into the cable (the grey wire on the drawings).

As soon as the interlock is broken, the HV relay switches off. A service plug often contains a piece of the interlock system as well.





High Voltage Interlock System







Ask the question, is the HV (hybrid) drive off? Yes, the airbags have disabled the HV battery.

What you see lit up now is the vehicle's 12V system.

ALTERNATIVE PROPULSION







- The 12V system is used to operate the available for the drive.
- Switching on ignition
- Via start/stop button or ignition key.
- DC from the battery pack to the AC inverter.
- Vehicle ready to drive.





• The 12V system is used to operate the HV relays (closing in this case). This makes HV



itch on propulsion



- By SRS activation
- Carry out a check!
- READY INDICATOR
- SRS control unit.
- Drive switched off.

The check is done by consulting the CRS.



Automatic shutd





lown in the event of an accident



- Vehicle still in operating mode after accident
- Carry out a check!
- READY INDICATOR
- Disconnecting 12 V is not sufficient.
- Ignition and/or secondary deactivation method.

the on-board network!





Again, follow the descriptions in the CRS to deactivate. If the 12 V battery is disconnected and the emergency lights remain on, the HV battery is still in operation and can supply power to





SECONDARY DEACTIVATI

- Most Hybrid and electric vehicles are equipped with one or more emergency circuits
- Wear 1000 Volt gloves when advised
- These emergency circuits are not always part of the HV system

CAUTION! These emergency c 12/24 volts remains









ON

ircuits only switch off the propulsion. s active!









- Determine if the battery pack is involved in the fire If so, consider letting the vehicle burn out. - Battery pack is built-in and therefore difficult to reach for cooling.
- If the battery pack is not yet involved in the fire, it is a normal car fire.
- If there is a chance of spreading to a building or other vehicles, this must be prevented.
- No risk of electrocution when applying water.

Advantages:

- a burning battery pack.
- No more electrical power.
- No more battery fluid. (electrolyte)
- No chance of re-ignition.

Preventively submerge a suspect electric vehicle in a water tank.



• No polluted extinguishing water. Tesla recommends using a lot of water (10,000 litres!) to extinguish



Battery cell on fire.

- All extinguishing agents are tested.
- Not a single one is effective.
- A lot of water is needed.
- Thermal runaway.
- Above 150 degrees.

Water is currently the only easily available extinguishing agent for Li-Ion batteries. Also consider submerging the battery in a container or the like.



nium-ion batteries



- vehicle away after an accident.
- Even when the cells do not appear to be affected!









Always take into account possible cell reactions when putting an electric







What is CNG?

- Compressed Natural Gas
- Methane
- Flammable gas
- Lighter than air
- Odorant
- ~ 200 bar









How can a damaged CNG system be made safe?

- Clear and mark the danger zone
- Remove possible ignition sources
- Prepare extinguishing agents
- Remove car from confined space
- Determine gas concentration with measuring instruments; pay attention to gas concentrations in vehicle cavities







CRS symbol of a gas shut-off valve with overpressure and melting safety device.



ALTERNATIVE PROPULSION



Safety valve



- ball is free and gas can flow out.
- This prevents the formation of an explosive gas cloud.







• When the pressure in the bottle and the connected pipe are equal, the shut-off

• If the pipe breaks, the pressure difference is too great and the shut-off valve (flow prevention device) will close and the gas bottle will slowly empty.











This gas valve has two possibilities, the electric valve that is operated by 12 or 24 Volt and the shut-off valve that can be closed with an Allen key.





Blowing off an LPG installation in a passenger vehicle.

How do you handle this gas installation in this situation?









What kind of gas do you expect?

Accident is probably LPG

ALTERNATIVE PROPULSION



Extinguish gas installation







From 110°C, the safety device melts and blows off the cylinder in a few minutes to prevent an explosion.

ALTERNATIVE PROPULSION





et
INormal situ
Glass tube
Outlet
Temperatu

nermal protection



Liquified Petroleum Gas

- Propane/Butane
- Flammable gas
- Heavier than air
- Odorant
- 8-10 bar











Pressure relief valve LPG, it blow below 27 bar.











Pressure relief valve LPG, it blows off and closes again when the pressure drops

pressure relief valve









nger of explosion



What is going on here?

How should this be solved?

the gas outflow with a jet. Pay attention to wells and ditches, where the gas accumulates).





(Measure with an Ex meter, close the valve manually, in case of leakage, check



Toyota Mirai, fully hydrogen powered!



ALTERNATIVE PROPULSION







Pressures currently up to 700 bar vehicles.

Also overpressure and melting fuses as with CNG on the cylinders.



Install safely: Centre rear fuel storage, heavily reinforced gas cylinders



Pressures currently up to 700 bar in passenger cars, up to 350 bar in larger



CRASH Recovery System[®]

- Solenoid shut-off
- valve
- Temperature protection
- Overpressure protection
- Pressure drop protection





Safety valve



Detection of hydrogen gas by means of sensors in the vehicle.

At the tanks, in the interior and engine compartment.

System shuts down the fuel cell and/or vehicle (FCU)













- 14 times lighter than air (gas).
- Ignition temperature = 585°C.
- Odourless.
- Explosion limit 4 and 96 vol%.
- Ignition energy 0.02 mJ.
- Ignition energy Methane 0.23 mJ.





ysical properties



If the direction in which a gas system blows off is known, this is indicated by red arrows in the Crash Recovery System.

The blow off direction is downwards.

or similar.





Consider the load-bearing structure if there is a fire in this vehicle in a car park





With this car on its side, the blow-off direction is naturally also sideways.

- No flames visible.
- No heat radiation.
- Sharp audible sound.
- Use thermal imaging camera.
- Temperature 1300°C.









Chapter 5 CRASH RECOVERY SYSTEM







CRASH RECOVERY SYSTEM

Practical exercise 1 - How safe is the vehicle?

Search for the vehicles in the Activity sheets in the CRS via the manual selection procedure, and answer the following questions:

- What safety systems are p
- What is the primary deacting





resent in the vehicle? ation method?



CRASH RECOVERY SYSTEM

Practical exercise 2 - What is your plan B?

Look at the number plates in the Activity sheets. Look up the number plates using the number plate selection. If you do not have a CRS with number plate selection, you can also look up the vehicles manually (results are mentioned).

- What is the secondary deactivation method?







THANK YOU FOR THE ATTENTION!

CRASH Recovery System[®] For more information about Moditech website and social media channels:

NWW.MODITECH.COM

WWW.FACEBOOK.COM/MODITECHRESCUE

WWW.LINKEDIN.COM/COMPANY/MODITECHRESCUE

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and the Crash Recovery System, please visit our