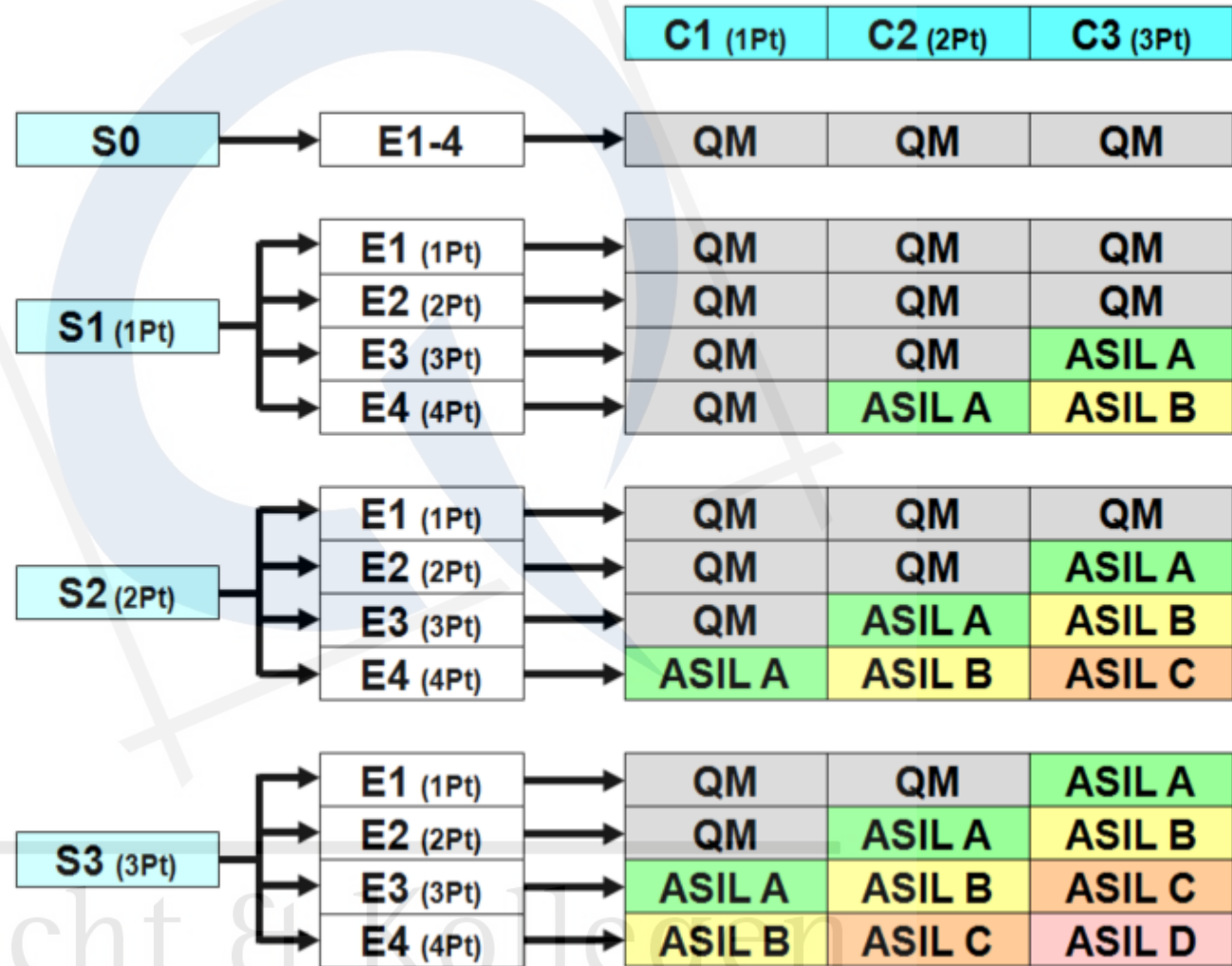


Overview of Classifications

Severity	
S0	No injuries
S1	Light and moderate injuries (arm hurted)
S2	Severe and life-threatening injuries (survival probable - arm detached)
S3	Life-threatening injuries (survival uncertain), fatal injuries (head detached)
Exposure (Duration + Frequency)	
E0	Incredible
E1	Very low probability
E2	Low probability
E3	Medium probability
E4	High probability
Controllability	
C0	Controllable in general
C1	Simply controllable
C2	Normally controllable
C3	Difficult to control or uncontrollable



S0 or E0 or C0 → always QM

Description of Severity

SO	S1	S2	S3
AIS 0 and less than 10% probability of AIS 1-6 Damage that cannot be classified safetyrelated	More than 10% probability of AIS 1-6 (and not S2 or S3)	More than 10% probability of AIS 3-6 (and not S3)	More than 10% probability of AIS 5-6
<p>Bumps with roadside infrastructure</p> <p>Pushing over roadside post, fence, etc.</p> <p>Light collision</p> <p>Light grazing damage</p> <p>Damage entering/exiting parking space</p> <p>Leaving the road without collision or rollover</p>	<p>Side impact with a narrow stationary object, e.g. crashing into a tree (impact to passenger cell) with very low speed</p> <p>Side collision with a passenger car (e.g. intrudes upon passenger compartment) with very low speed</p> <p>Rear/front collision with another passenger car with very low speed</p> <p>Collision with minimal vehicle overlap (10 % to 20 %)</p> <p>Front collision (e.g. rear-ending another vehicle, semi-truck, etc.) without passenger compartment deformation</p>	<p>Side impact with a narrow stationary object, e.g. crashing into a tree (impact to passenger cell) with low speed</p> <p>Side collision with a passenger car (e.g. intrudes upon passenger compartment) with low speed</p> <p>Rear/front collision with another passenger car with low speed</p> <p>Pedestrian/bicycle accident while turning (city intersection and streets)</p>	<p>Side impact with a narrow stationary object, e.g. crashing into a tree (impact to passenger cell) with medium speed</p> <p>Side collision with a passenger car (e.g. intrudes upon passenger compartment) with medium speed</p> <p>Rear/front collision with another passenger car with medium speed</p> <p>Pedestrian/bicycle accident (e.g. 2-lane road)</p> <p>Front collision (e.g. rear-ending another vehicle, semi-truck, etc.) with passenger compartment deformation</p>
Source: ISO 26262-3:2011, Table B.1 — Examples of severity classification			

Description of Controllability



CO	C1	C2	C3
Controllable in general	99% or more of all drivers or other traffic participants are usually able to avoid harm	90% or more of all drivers or other traffic participants are usually able to avoid harm	Less than 90% of all drivers or other traffic participants are usually able, or barely able, to avoid harm
<p>Situations that are considered distracting</p> <p>Unexpected radio volume increase</p> <p>Warning message – gas low</p> <p>Unavailability of a driver assisting system</p>	<p>Faulty adjustment of seat position while driving</p> <p>Blocked steering column when starting the vehicle</p>	<p>Failure of ABS during emergency braking</p> <p>Headlights fail while night driving at medium/high speed on unlighted road</p> <p>Motor failure at high lateral acceleration (motorway exit)</p>	<p>Failure of ABS when braking on low friction road surface while executing a turn</p> <p>Failure of brakes</p> <p>Incorrect steering angle with high angular speed at medium or high vehicle speed (steering angle change not aligned to driver intent)</p> <p>Faulty driver airbag release when travelling at high speed</p>
<p>NOTE 1: For C2, a feasible test scenario in accordance with RESPONSE 3 (see Reference [3]) is accepted as adequate: “Practical testing experience revealed that a number of 20 valid data sets per scenario can supply a basic indication of validity”. If each of the 20 data sets complies with the pass-criteria for the test, a level of controllability of 85% (with a level of confidence of 95% which is generally accepted for human factors tests) can be proven. This is appropriate evidence of the rationale for a C2-estimate.</p> <p>NOTE 2: For C1 a test to provide a rationale that 99% of the drivers “pass” the test in a certain traffic scenario might not be feasible because a huge number of test subjects would be necessary as the appropriate evidence for such a rationale.</p> <p>NOTE 3: As no controllability is assumed for category C3, it is not relevant to have appropriate evidence of the rationale for such a classification.</p>			
Source: ISO 26262-3:2011, Table B.4 — Examples of possibly controllable hazardous events by the driver or by the persons potentially at risk			

Description of Exposure (Duration)

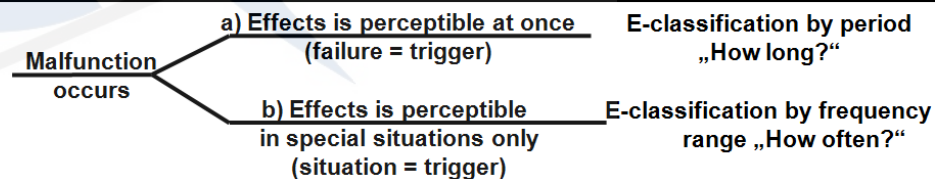
E1	E2	E3	E4
Not specified	<1% of average operating time	1% to 10% of average operating time	>10% of average operating time
Lost cargo or obstacle in lane of travel (highway) Vehicle during jump start In repair garage (on roller rig) Driving downhill with engine off (mountain pass)	Mountain pass with unsecured steep slope Country road intersection Highway entrance ramp Highway exit ramp Snow and ice on road Slippery leaves on road In car wash Nearing end of congestion Trailer attached Roof rack attached Vehicle being refuelled In repair garage (during diagnosis or repair) On hoist Driving in reverse (from parking spot) Driving in reverse (city street) Overtaking Parking (with sleeping person in vehicle) Parking (with trailer attached)	One-way street (city street) Wet road In tunnel Traffic congestion Vehicle on a hill (hill hold) Heavy traffic (stop and go) Unlighted roads at night	Highway Secondary road Country road Accelerating Decelerating Executing a turn (steering) Parking (parking lot) Lane change (city street) Stopping at traffic light (city street) Lane change (highway)

Source: ISO 26262-3:2011, Table B.2 — Classes of probability of exposure regarding duration in operational situations

Description of Exposure (Frequency)

E1	E2	E3	E4
Occurs less often than once a year for the great majority of drivers	Occurs a few times a year for the great majority of drivers	Occurs once a month or more often for an average driver	Occurs during almost every drive on average
Stopped, requiring engine restart (at railway crossing) Vehicle being towed Vehicle during jump start	Mountain pass with unsecured steep slope Snow and ice on road Trailer attached Roof rack attached Evasive manoeuvre, deviating from desired path	Wet road In tunnel In car wash Traffic congestion Vehicle being refuelled Vehicle on a hill (hill hold) Overtaking	Starting from standstill Shifting transmission gears Accelerating Braking Executing a turn (steering) Using indicators Manoeuvring vehicle into parking position Driving in reverse

Source: ISO 26262-3:2011, Table B.3 — Classes of probability of exposure regarding frequency in operational situations



Speed-Definitions	Speed-Range
very low speed	maximum 15 km/h - Definition according to ISO 26262, part 10, page 11
low speed	16 km/h - 50 km/h [i-Q own definition, to fill up gap in standard]
medium speed	51 km/h - 90 km/h - Definition according to: ISO 26262, part 10, page 12
high speed	> 90 km/h [i-Q own definition, to complete standard]

Situation Catalogue according VDA 702 (June 2015)

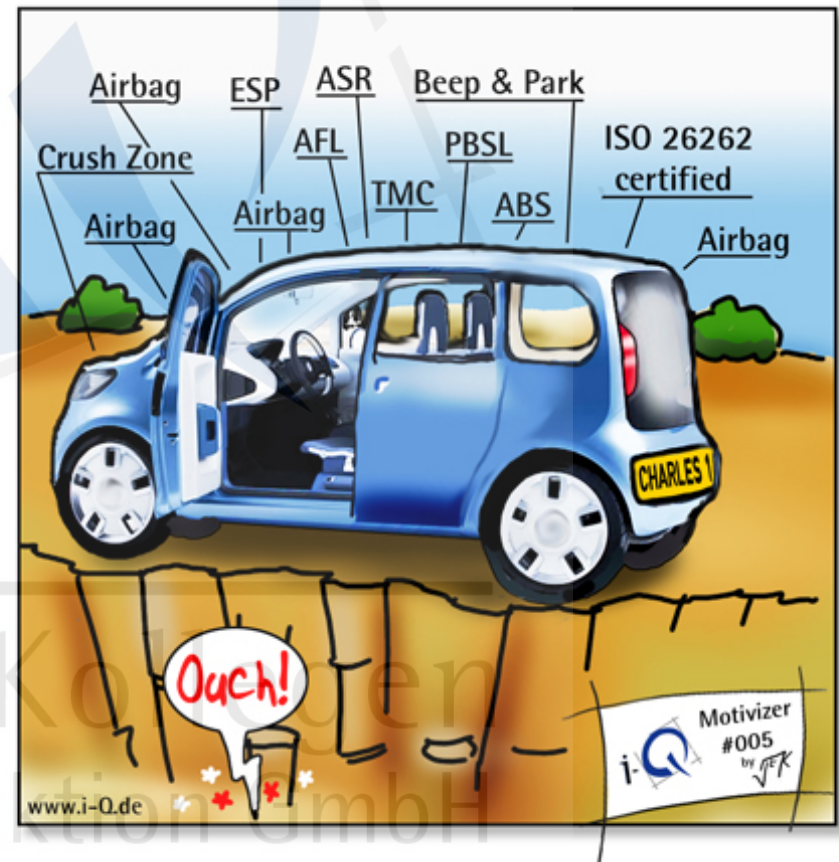


Ranked Situation	Duration	Frequenc
Driving at low visibility (fog / blinding) visibility range below 50m	E2	E2
Driving at darkness without remaining light (no road lighting, no moon, no lights from other traffic participants) --> roadside not visible	E3	---
Driving at darkness with remaining light (e.g. street lights, light of other traffic participants, twilight) --> roadside visible	E4	E4
1 passenger	E4	E4
2 passenger	E4	E4
>2 passenger	E3	E3
Driving on normal friction coefficient	E4	---
Driving with reduced friction coefficient in the range of $\mu < 0,8 \pm 0,1$ (e.g. heavy wet, lane grooves, split ...)	E3	---
Driving with low friction coefficient in the range of $\mu < 0,5 \pm 0,1$ (e.g. snow, ice ...)	E2	---
Driving on roads with μ -split. (deviation left / right with $\Delta\mu > 0,3$, e.g. change dry / wet / ice)	E1	E2
Driving on roads with μ -step (transition with $\Delta\mu > 0,3$, e.g. change dry / wet / ice)	E1	E3
Driving with heavy vertical excitation at the wheel (e.g. pothole, bump, cobblestone, speed bumper, curb ...)	E3	E3
Driving with velocity above 130km/h	E3	---
Driving with velocity above 180km/h	E2	---
Driving with velocity above 200 km/h	E1	---
Slow driving / start-up process ($0 < x < 12$ km/h)	E3	E4
Driving with normal longitudinal acceleration ($< 2 \text{ m/s}^2$)	E4	E4
Driving with longitudinal acceleration above 2 m/s^2	E3	E4
Driving with longitudinal acceleration above 4 m/s^2	E2	E3
Driving with normal deceleration ($< 4 \text{ m/s}^2$)	E4	E4
Driving with deceleration above 4 m/s^2	E2	E3
Driving with deceleration above 6 m/s^2 (e.g. emergency brake, ABS)	E1	E2
Performing a lane change (duration in which the vehicle is not completely on one lane only)	E3	E4
Backing up (inclusive switching)	E2	E4
Vehicle performs over taking maneuver (over taking with lane change to opposite lane only)	E2	E3
Driver performs gear change	E3	E4
Driving with active turn-indicator (excluding stand still)	E3	E4
Driver unfasten seat belt (from opening of belt lock until the belt is not longer in front of the body)	E2	E4
Driver fasten seat belt (from catching the belt until latching the belt into the belt lock)	E2	E4

Ranked Situation	Duration	Frequenc
In to and out of parking space	E3	E4
In to and out of parking space in longitudinal direction (Out of parking space: starting with the first movement of the vehicle until the vehicle is completely on the lane. Inclusive waiting times)	E2	E3
In to and out of parking space in cross direction (Out of parking space: starting with the first movement of the vehicle until the vehicle is completely on the lane. Including waiting time)	E3	E4
Stop at hill / on summit with inclinations between 2% and 8%	E3	E3
Stop at hill / on summit with inclinations $> 8\%$	E2	E2
Stop on street (e.g. in front of stop sign, traffic light, cross walk ...)	E4	E4
Stop on street (e.g. in front of stop sign, traffic light, cross walk ...) stand at the first place (no other vehicles in front)	E3	E4
Passing a crossroads, the vehicle crosses the lanes of other traffic participants (with / without traffic light, cross walk, cycle path)	E3	E4
Turning (starts with leaving the own lane until vehicle is completely on the crossroad.)	E3	E4
Free ride	E4	E4
Driving behind other vehicle with normal distance	E4	E4
Driving with opposing traffic within in visibility range	E4	E4
Driving with parking vehicle at the roadside	E4	E4
Driving with trailer	E2	E2
Driving with loaded roof box (e.g. box, bicycles)	E2	E2
Load up to maximum 100kg (excluding Passengers)	E4	E4
Load with > 100 kg (excluding Passengers)	E3	E3
Driving with compact spare tire	E1	E1
Driving with snow chains	E1	E1
Vehicle tows other car	E1	E1
Vehicle is towed (e.g. on axis, by another vehicle, ...)	E1	E1
Driving on the highway	E4	E3
Driving on the highway entrance	E2	E3
Driving on the highway exit	E2	E3
Driving on country road	E4	E4
Driving in the city	E4	E4
Driving on mountain pass	E2	E2
Traffic calmed area (also: play street)	E2	E3
Driving within speed limit area 30km/h	E3	E4

Ranked Situation	Duration	Frequenc
Driving in road construction works on dual carriageway	E3	---
Driving in road construction works on road without central reserve	E2	---
Driving in tunnel	E2	E3
Driving over railroad crossing	E1	E3
Stand still with driver in the vehicle and terminal15 off	E3	E4
Stand still with driver not in the vehicle (inclusive parking)	E4	E4
Stand still without driver, but with passengers in the vehicle	E3	E4
Vehicle stands still with engine running	E4	E4
Vehicle stands still with active driving standby (e-vehicle)	E4	E4
Long time parking >2 days	E4	---
Driver enters / deboards vehicle	---	E4
Driver release parking brake	---	E4
Driver starts the vehicle	---	E4
Trunk compartment is loaded / unloaded (person behind the opened trunk)	E2	E4
Vehicle is being refueled	E2	E3
E-vehicle is charged by charging cable (plug-in)	E4	E4
Driver checks / adds fluids at engine compartment (oil level, washer fluid ...)	E1	E2
Vehicle is lifted on the lifting ramp or car jack (e.g. wheel change)	E2	E2
Vehicle do not move because of a malfunction / breakdown	---	E1
Vehicle has an accident	---	E1
Vehicle is jump started	E1	E1
Parking in the car park	E4	E4
Parking in the garage	E4	E4
Parking at roadside (city)	E4	E4
Vehicle stands or parks at roadside or breakdown lane (highway)	E1	E1
Persons within danger zone (ca. 1 vehicle length in front of / behind standing / parking vehicle)	E3	E4
Person holds a part of the body out of side or roof window	E2	E3
Persons (also: children) on the vehicle (hood, roof ...)	E1	E1
Vehicle is inside of a car wash (also: washing box, hand wash ...)	E2	E3
Vehicle is transported (ship, ferry, train, truck)	E2	E1
Opening / closing of window or sun roof	E2	E3
Locking / unlocking of vehicle during standstill	---	E4
Driving with opened soft top (convertible only)	E3	E3

I thought I made it
fool-proof...
....but they proved
me wrong.



Vehicle Situations – Examples for HARA

Common Situations		Common Situations		Common Situations		Environmental Conditions		Driver's Activities	
Direction of Driving	turn	Special Driving Situations	circular path	Velocity	low velocity	Lane Characteristics	summit	Pedal Activities	braking pedal slightly pressed
	straight ahead		steep turn		high velocity		railroad crossing		braking pedal strongly pressed
	uphill		bridge		parking / switching		aquaplaning		releasing brake pedal
	downhill / pass		tunnel		highway		single damages		braking pedal not pressed
	standstill		racing circuit		country road		off road		braking pedal touched
driving backwards	crest [Berggipfel]		Environmental Conditions				mud		accelerator pedal slightly pressed
slightly accelerating	wash tunnel, carwash		Temperature	heat	wet grassland		accelerator pedal strongly pressed		
strongly accelerating	lateral inclination			coldness	snow		releasing accelerator pedal		
coasting with running engine	jerky [ruckartig] steering (steering angle sensor step / staggered)			change of temperature	transversal slope		accelerator pedal not pressed		
coasting with engine OFF, ignition ON	elk test			room temperature	interconnection		accelerator pedal touched		
coasting with engine OFF, ignition OFF	chassis dynamometer test bench			heat emission	passing a creek		clutch pedal pressed completely		
constant speed	automatic gearbox emergency program			Irradiation [Einstrahlung]	boulders, gravel, sand		clutch pedal slightly pressed		
Deceleration	partial braking		engine emergency program	Air	refrigeration, cooling	Visibility & Weather Conditions	bedrock	Hand	clutch pedal slipped (no complete release)
	full brake application		engine failure (coasting to standstill) ignition ON		high mountains		racing circuit		clutch pedal released
	automatic brake		car / trailer combination	Humi.	Dead See		take off due to curbs		clutch pedal not pressed
	application of parking brake (emergency brake)		driving with roof rack		tropics		fog		clutch pedal touched
Traffic	platoon		towing vehicle away, ignition and engine ON	Dirtiness Condit.	desert		night	Miscellaneous Situations & Criteria	hand brake lever operated
	opposing traffic		towing rope		desert sand		day		EPB control element operated
	traffic jam		tow bar		dust		thunderbolt		playing children in passenger compartment
	urban traffic		on a ferry / motor rail train		salt spray		storm		children seat on front passenger seat
Parking	Parking with strong tilt (transport on a ship, double carport, carpark, ...)	on a rotary disc in car park	Lane Characteristics	agriculture	rain		animals in passenger compartment		
	Parking at a slope (downhill)	common work in a garage		droppings	hail		driver enters vehicle without opening the door (convertible)		
	Parking at a slope (uphill)	diagnosis interface operation		friction factor	sun		driver leaves vehicle without opening the door (convertible)		
	getting into a parking lot	getting started with a battery jumper cable		low μ	blinding		humidity in passenger compartment		
		seasonal operation (e.g. for six month)		high μ	ultraviolet radiation				
		u-turn using the hand brake		μ split	heating of passenger compartment				
				Crash Situation	rear collision				
					frontal collision				
					lateral collision				
				rollover					
				fire brigade at work					

