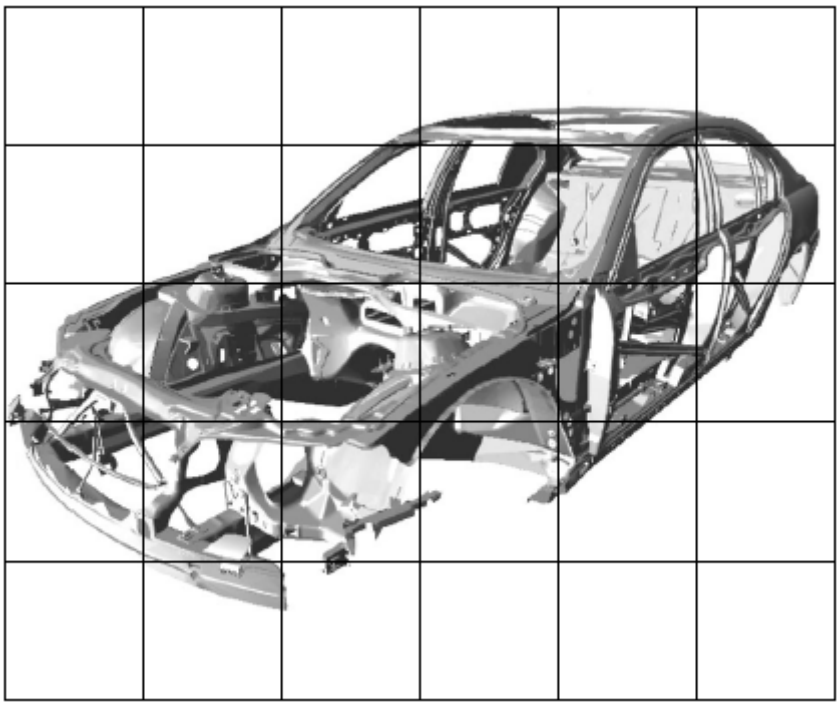
E65 Bodyshell



Introduction

The E65/E66 comes in 8 body variants. There are the following different variants for the models:

- Normal version E65 left-hand drive with/without sliding sunroof
- Normal version E65 right-hand drive with/without sliding sunroof
- Long version E66 left-hand drive with/without sliding sunroof
- Long version E66 right-hand drive with/without sliding sunroof

Sheet panels of different material thicknesses and different steel types have been used. These factors together with strength bonding produce the following advantages:

- The unladen weight of the vehicle is reduced, thereby lowering energy consumption.
- Improved crash performance results in increased passive safety.
- Increased body rigidity results in improved directional stability.
- A reduction of vibrations and acoustic noises provides the driver with increased driving comfort.

Requirements of body structure

The body structure is designed in accordance with the following standpoints:

- Static performance
- Dynamic performance
- Crash performance
- Weight optimization

- Static performance

Good static rigidity serves as the basic prerequisite for good dynamic performance.

The flexural strength, torsional resistance and transversal rigidity of the body are all determined by the design.
The strength is determined by the choice of materials used (high-tensile steels) and by the additional bonding of welding flanges.

- Dynamic performance

The aim of dynamic configuration of the body structure is to achieve the vibrational and acoustic comfort objectives.

- Crash performance

Static and dynamic performance forms an outstanding basis for crash optimization, which in turn serves to improve passive passenger protection.

- Weight optimization

Next to aerodynamics, vehicle weight is the most important factor in reducing fuel consumption and improving handling performance.

Materials

Roughly 90% of the sheet panels used in the bodyshell consists of higher-tensile steels.

The properties of the steel types are described among others by the tensile yield strength:

The tensile yield strength denotes the strain value where, if this is exceeded, marked changes in the structure of the material can occur. Loading the material beyond its yield strength will generally result in permanent deformation (elongation). Cold reworking can then bring about a change in the molecular structure of the steel and thus a change in its properties, e.g. reduced passive safety. For this reason, narrow limits are set to cold reworking.
Only experience figures are helpful here because it is not possible to measure on the vehicle the extent to which the yield strength is exceeded. The components must be replaced in cases of doubt.

Applicable here are the specifications of Repair Instruction RA 4100..., which must be observed without fail.

The choice of materials is to be taken from the exploded views for the body structure. The different materials are distinguished by colour in these views.

Surface treatment

- Galvanizing

Full galvanizing of all the steel sheets is necessary because galvanizing prevents corrosion.

There are three different galvanizing methods: electrolytic galvanizing, hot-dip galvanizing and electrogalvanizing.

In order to maintain corrosion protection in the event of repairs, it is necessary to take measures which are described in the section entitled "Body repairs of galvanized sheets."

- Painting

Paint is applied in an environmentally friendly way:

- Cathodic dip painting (CDP)
- Multicolour extender
- Water-based paint
- Transparent powder paint

The engine and luggage compartments are painted with extender adapted to the basic colour.

The colour chart for the E65 comprises 13 different colours, which have partly been redeveloped.

Joining techniques

- Body joining techniques

The following different joining techniques are used on the E65:

- Spot-weld bonding
- Shielded arc welding (MAG process)
- Laser welding
- MIG soldering
- Bordering

Further information can be found in TIS: RA 4100... (Welding and soldering steel parts).

- Joining techniques for aluminium parts

The following joining techniques are used for joining aluminium parts:

- Punch riveting
- Bordering
- Clinching

- Tailored blanks

Tailored blanks are used in the E65 in the inner side frame and in the inner door panel.

In the event of repairs, the laser seam must not be disconnected!

- Bonding

Compared with the E38, the bonding length of the spot-weld-bonded joints has increased significantly from 2% to approx. 70%.

Bonding improves the static torsional rigidity of the body.

Advantages of bonding

Bonding offers the following advantages:

- Increase in rigidity
- Significantly improved deformation behaviour
- Stabilization of the carrier profile sections and connections through reduction of denting susceptibility in the flange area
- Corrosion protection

Areas where bonding is used

- Mixed construction (connection of different materials)
- Seam seal
- Structural bond

- Local reinforcement
- Folded seam bond

The reasons for the bonds at the individual flanges are to be taken from the following exploded views.

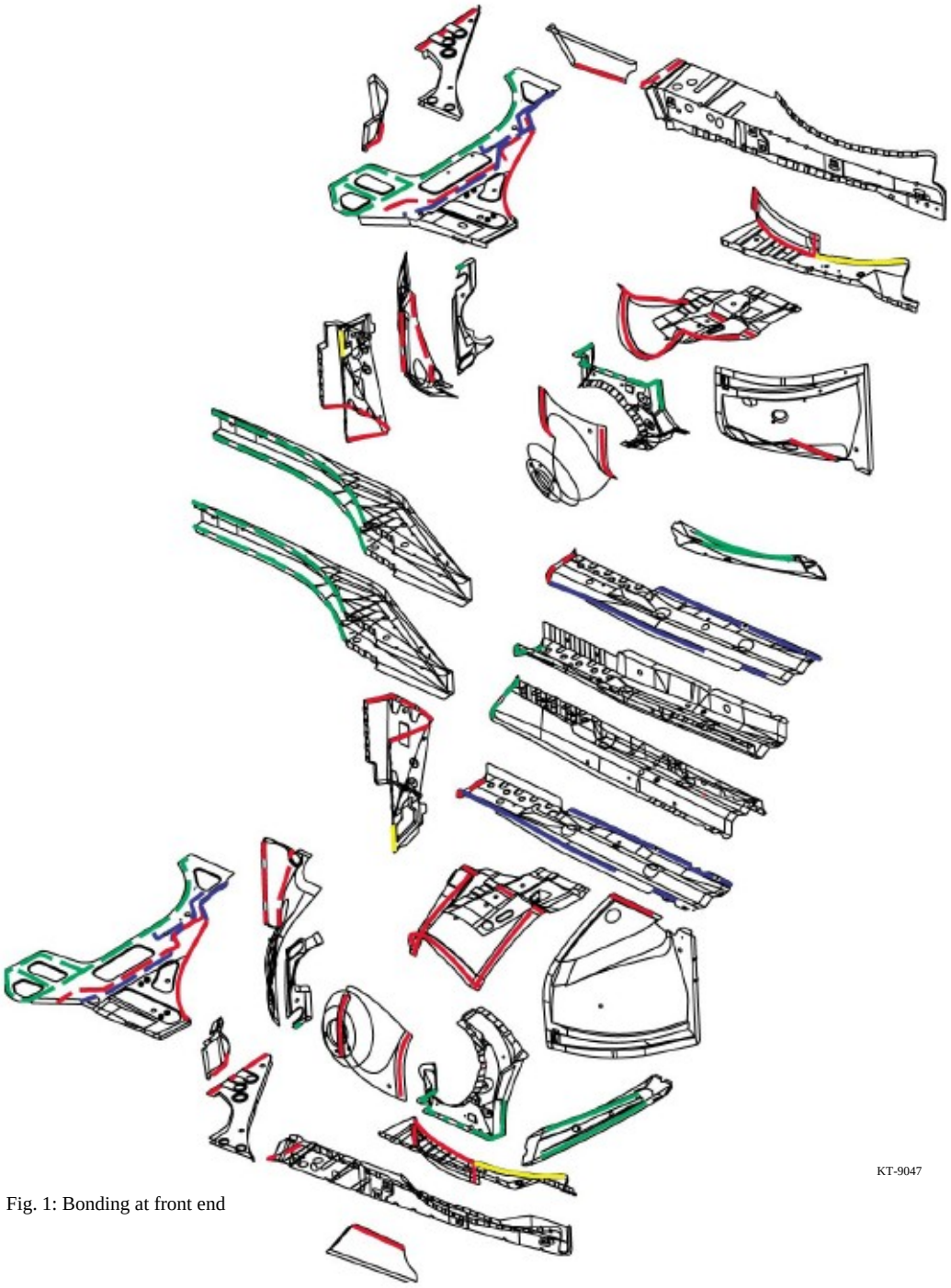


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Fig. 1: Bonding at front end

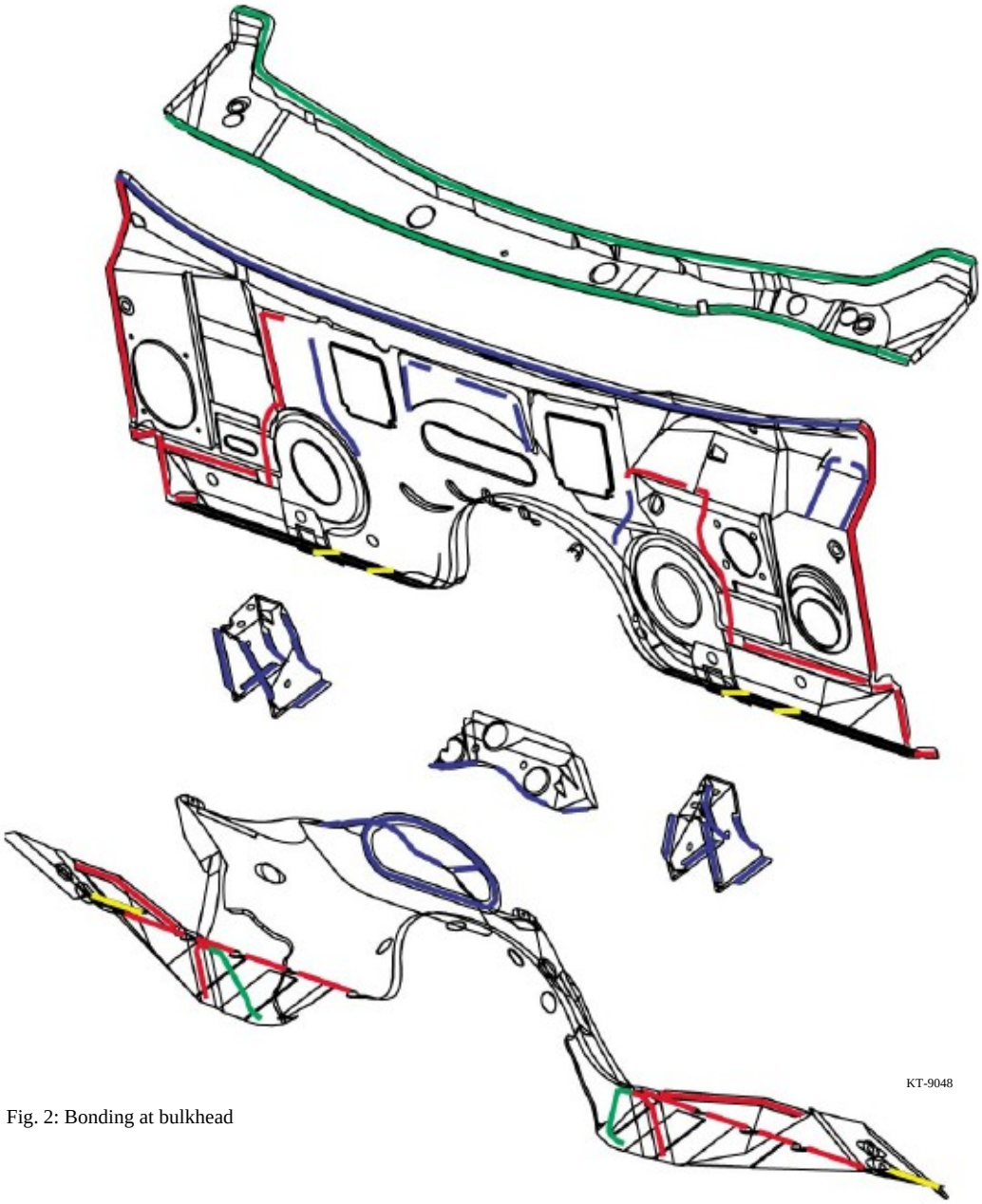

Fig. 2: Bonding at bulkhead

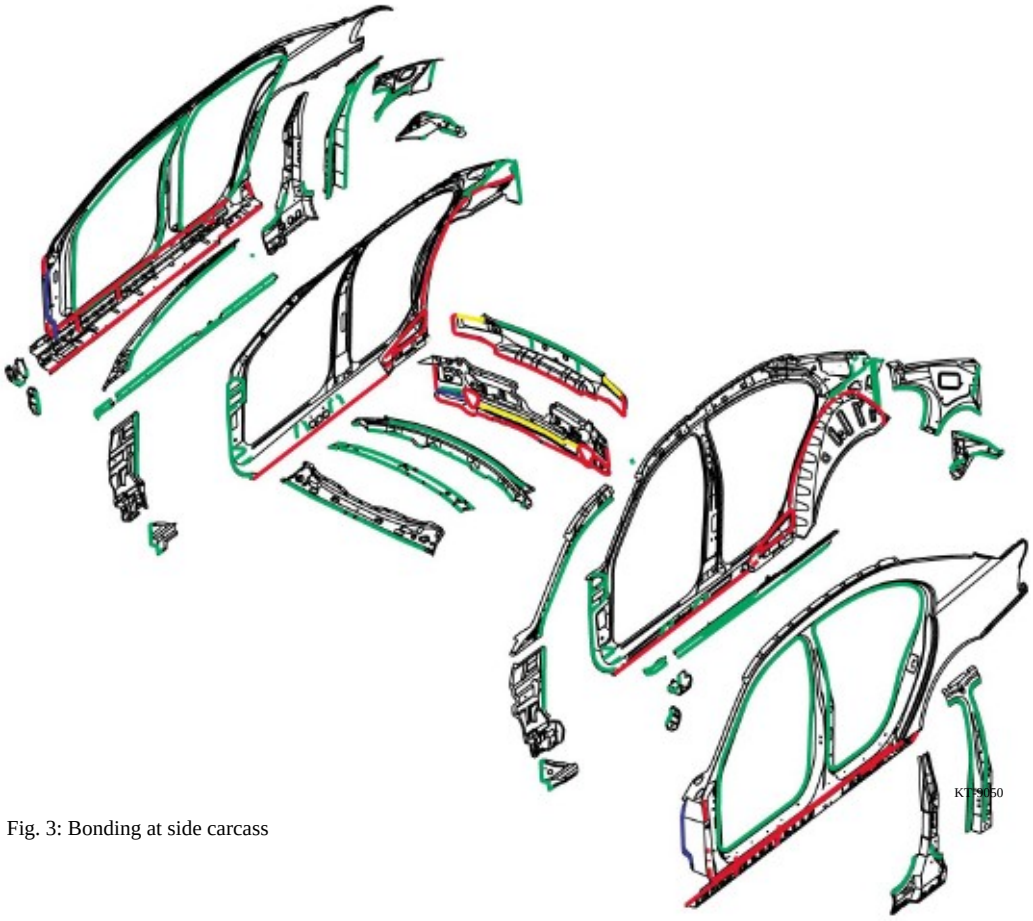

Fig. 3: Bonding at side carcass

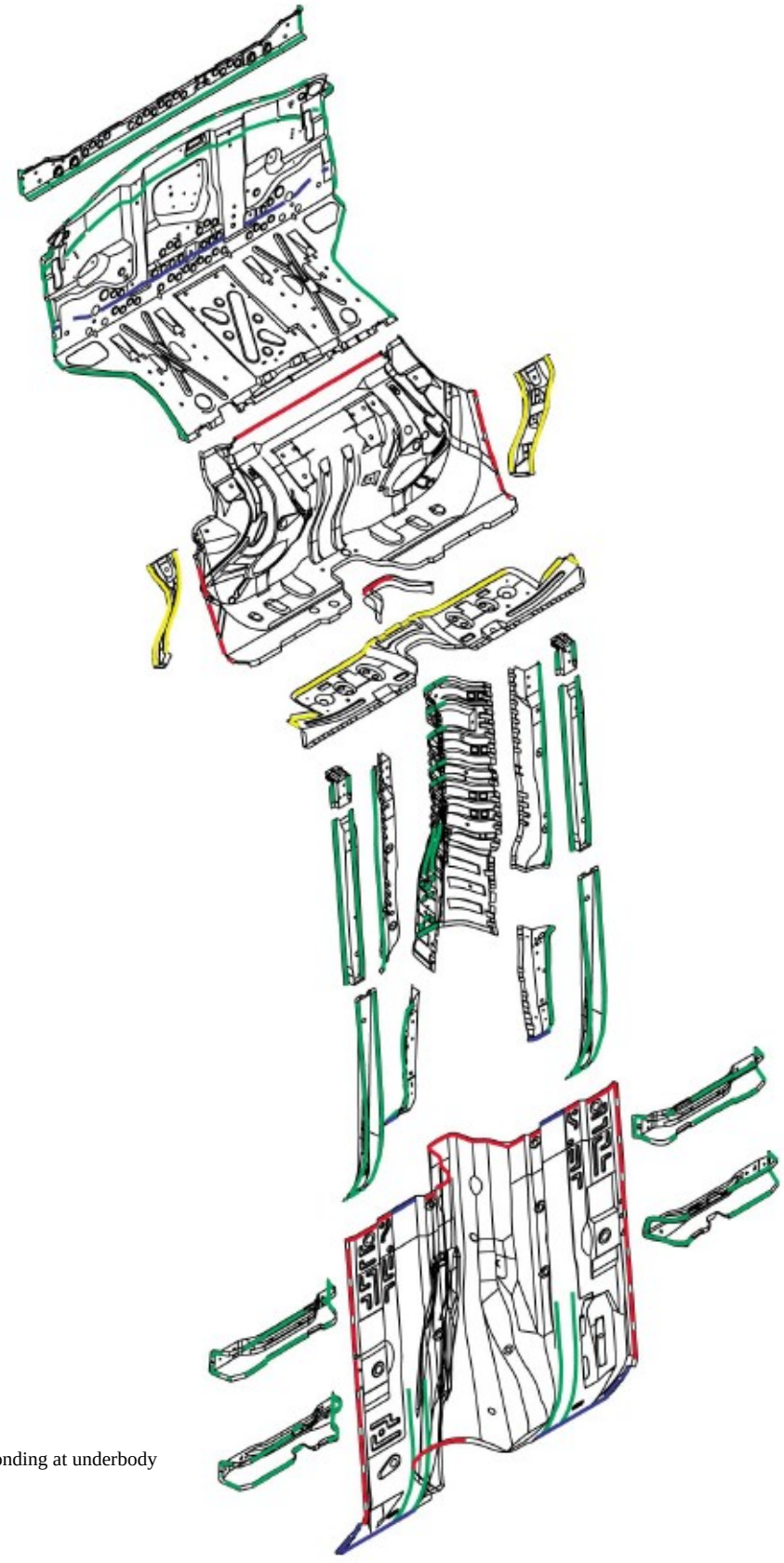

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Fig. 4: Bonding at underbody

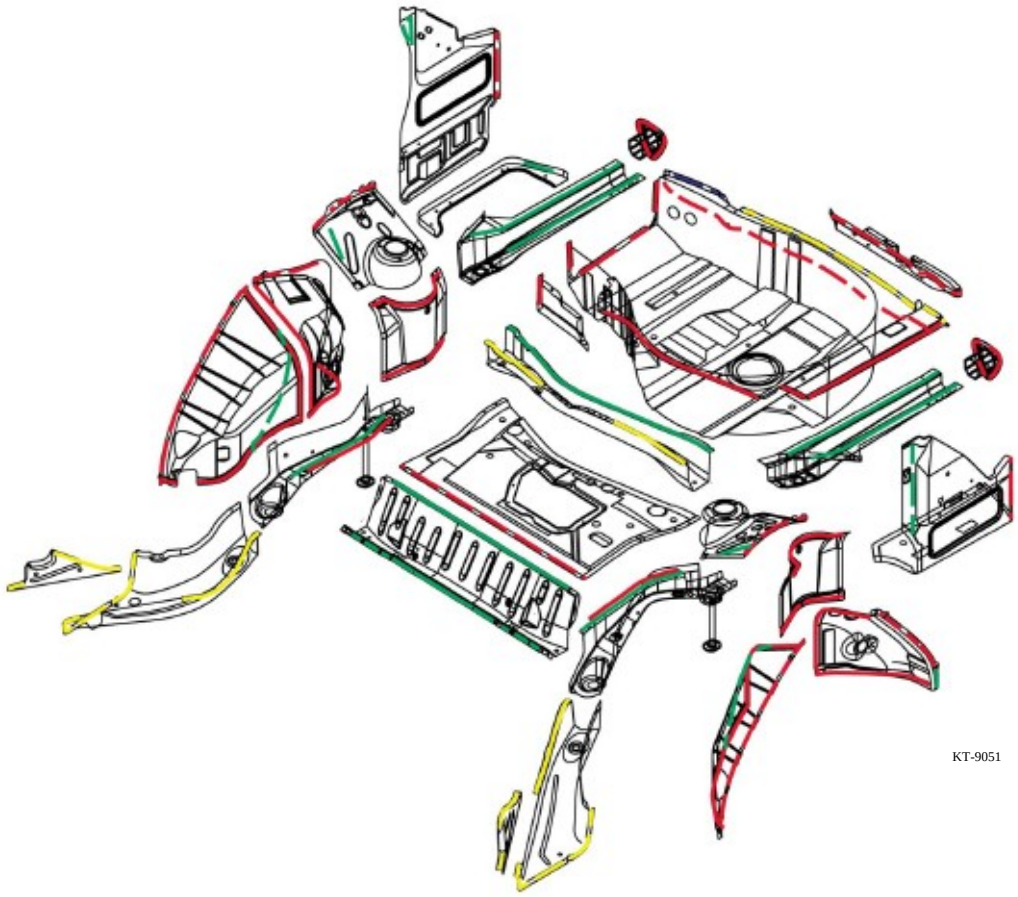

Fig. 5: Bonding at rear end

Index	Description
(red)	Bond in a heavily corrosion-prone area. Additional PVC coating or cavity sealant required.
(yellow)	Bond in a heavily corrosion-prone area. Additional PVC coating or cavity sealant required. After series optimization, reduction of additional corrosion protection envisaged.
(blue)	Bond in a heavily corrosion-prone area. PVC coating or cavity sealant is not applied.
(green)	Bonding flange in a non-corrosion-prone area. Pure structural bond.

Notes on use of bonding agent

The bonding process requires strict adherence to the specified parameters such as a dry, clean bonding surface.

In order to ensure an adequate bonding quality, there must be a low emergence of bonding agent at the bonding seam.

Procedure for repairs

A two-component bonding agent is used in the event of repairs.

The sheets are spot-welded after the bonding agent has been applied.

Other welding processes (soldered and inert-gas seams) are currently being assessed but generally result in the bonding agent being burnt.

In the event of repairs, observe the "Notes on bonding steel parts" in TIS (RA 4100...).

Body structure

- Front end

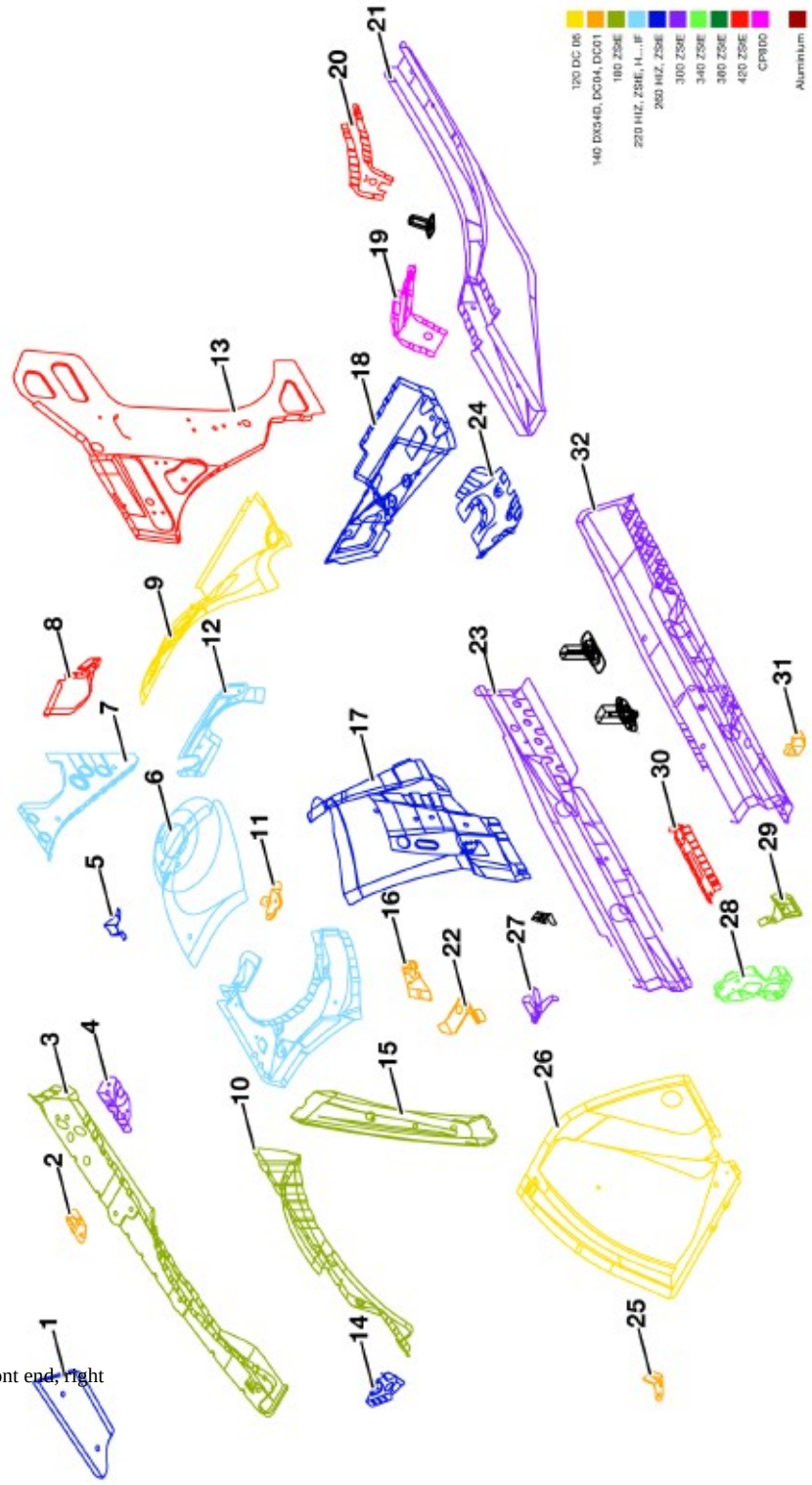

Fig. 6: Front end, right

Index	Description
1	End piece, support carrier, wheel arch, outer
2	Bracket for speed sensor
3	Support carrier, wheel arch, front
4	Attachment, hinge, engine bonnet
5	Attachment, pneumatic spring, engine bonnet
6	Spring support, top section
7	Connection, side frame, front
8	End piece, connection, side frame, front
9	Wheel arch, front, rear liner
10	Support carrier, wheel arch, front, inner
11	Attachment, ABS, top
12	End piece, equipment compartment
13	A-pillar, inner
14	Cross bulkhead, support carrier, wheel arch
15	Diagonal strut, engine carrier
16	Attachment, ABS, bottom rear
17	Spring support, bottom section
18	Connection, outer
19	Bulkhead plate, engine carrier, rear
20	Reinforcement, engine carrier, rear
21	Engine carrier, rear
22	Attachment, ABS, bottom front
23	Engine carrier, front, outer
24	Shoe, connection, outer
25	Bracket, side panel
26	Wheel arch, front, front liner
27	Holder, brake hose
28	Attachment, cross-member
29	Attachment, radiator
30	Steering bulkhead, engine carrier, front
31	Angle, attachment, cross-member, front
32	Engine carrier, front, inner

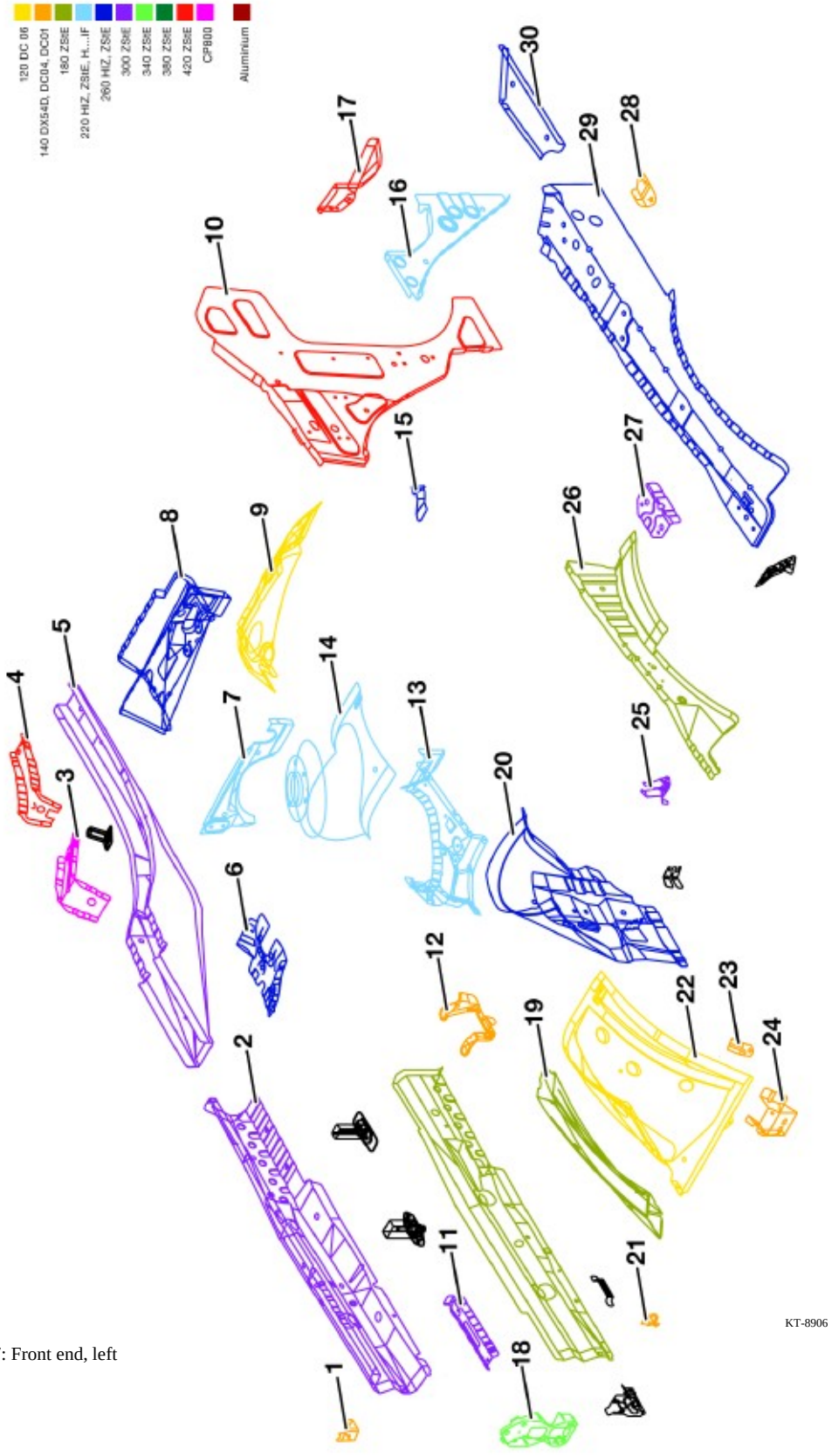

Fig. 7: Front end, left

Index	Description
1	Angle, attachment, cross-member, front
2	Engine carrier, front, inner
3	Bulkhead plate, engine carrier, rear
4	Reinforcement, engine carrier, rear
5	Engine carrier, rear
6	Shoe, connection, outer
7	End piece, equipment compartment
8	Connection, outer
9	Wheel arch, front, rear liner
10	A-pillar, inner
11	Steering bulkhead, engine carrier, front
12	Holder, water valve
13	Carrier, spring support
14	Spring support, top section
15	Attachment, pneumatic spring
16	Connection, side frame, front
17	End piece, connection, side frame, front
18	Attachment, cross-member
19	Diagonal strut, engine carrier
20	Spring support, bottom section
21	Holder, fluid reservoir, front
22	Wheel arch, front, front liner
23	Bracket, side panel
24	Holder, fluid reservoir, wheel arch
25	Holder, ABS
26	Support carrier, wheel arch, front, inner
27	Attachment, hinge, engine bonnet
28	Bracket for speed sensor
29	Support carrier, wheel arch, front
30	End piece, support carrier, wheel arch, front

The front bumper cross-member is made from aluminium.

A large part of the impact energy is absorbed by the honeycomb-structured aluminium deformation elements in the profile section which are bolted to the bumper cross-member.

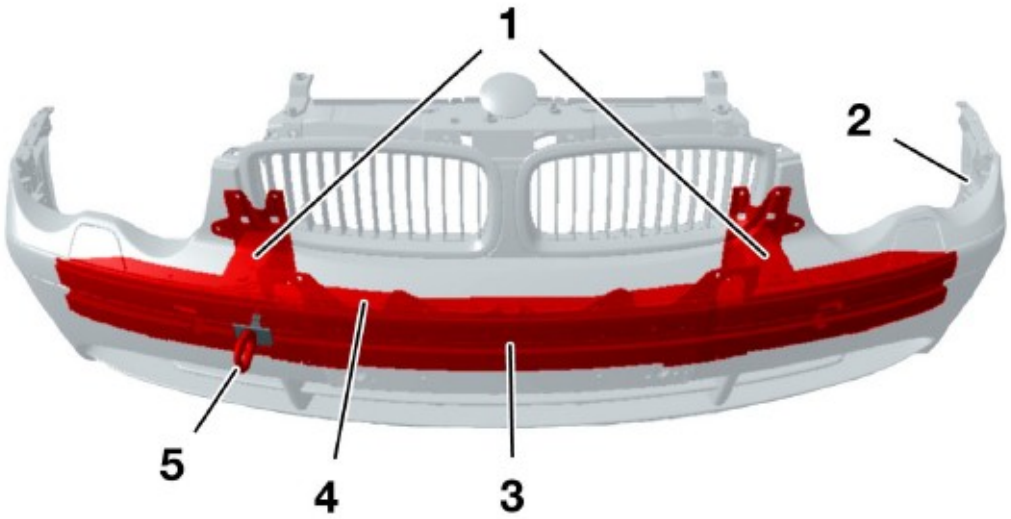

Fig. 8: Structure, front bumper

Index	Description
1	Deformation elements
2	Bumper trim
3	Polystyrene-foam impact absorber
4	Bumper cross-member
5	Tow hook

The front panel consists of aluminium and is bolted together to form a three-part unit.

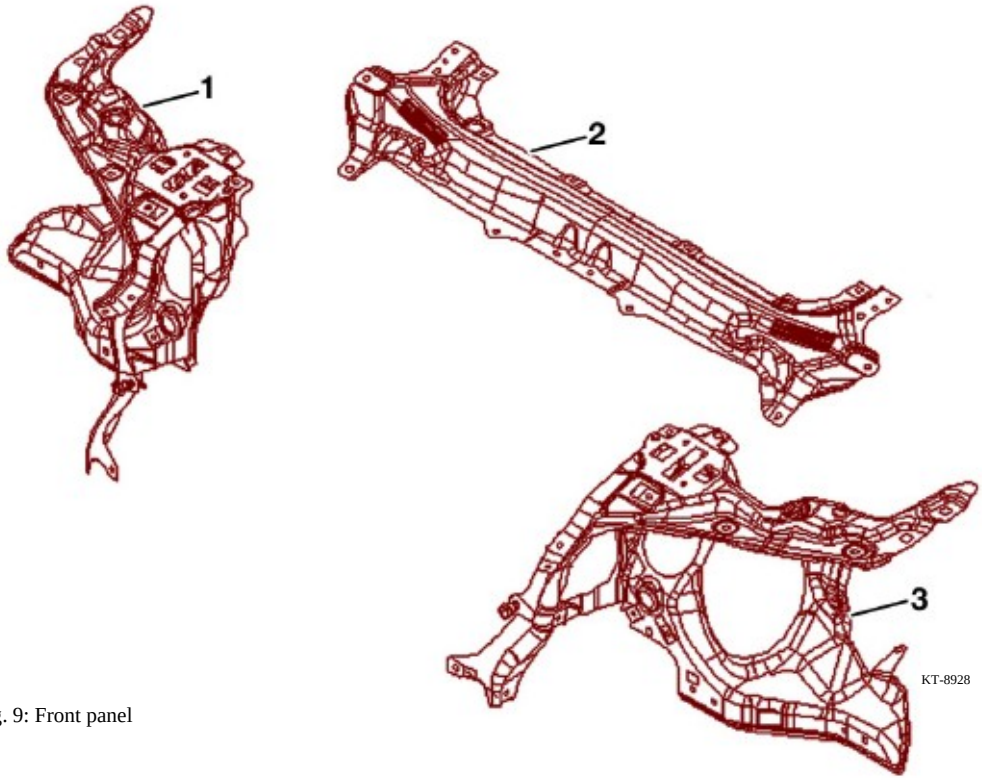

Fig. 9: Front panel

The engine carriers are designed in the profile section as a double hexagon.

Front-axle attachments are integrated in the engine carrier.

The wheel arch has a diagonal strut made from an IHPD profile section (internal high-pressure deformation).

A similar IHPD profile section has been fitted in the E46 Convertible in the windscreen frame as a rollover protective structure.

Note:
Because of their special properties, these profile sections cannot be reworked after a deformation. They must therefore be replaced after any deformation.

- Side carcass

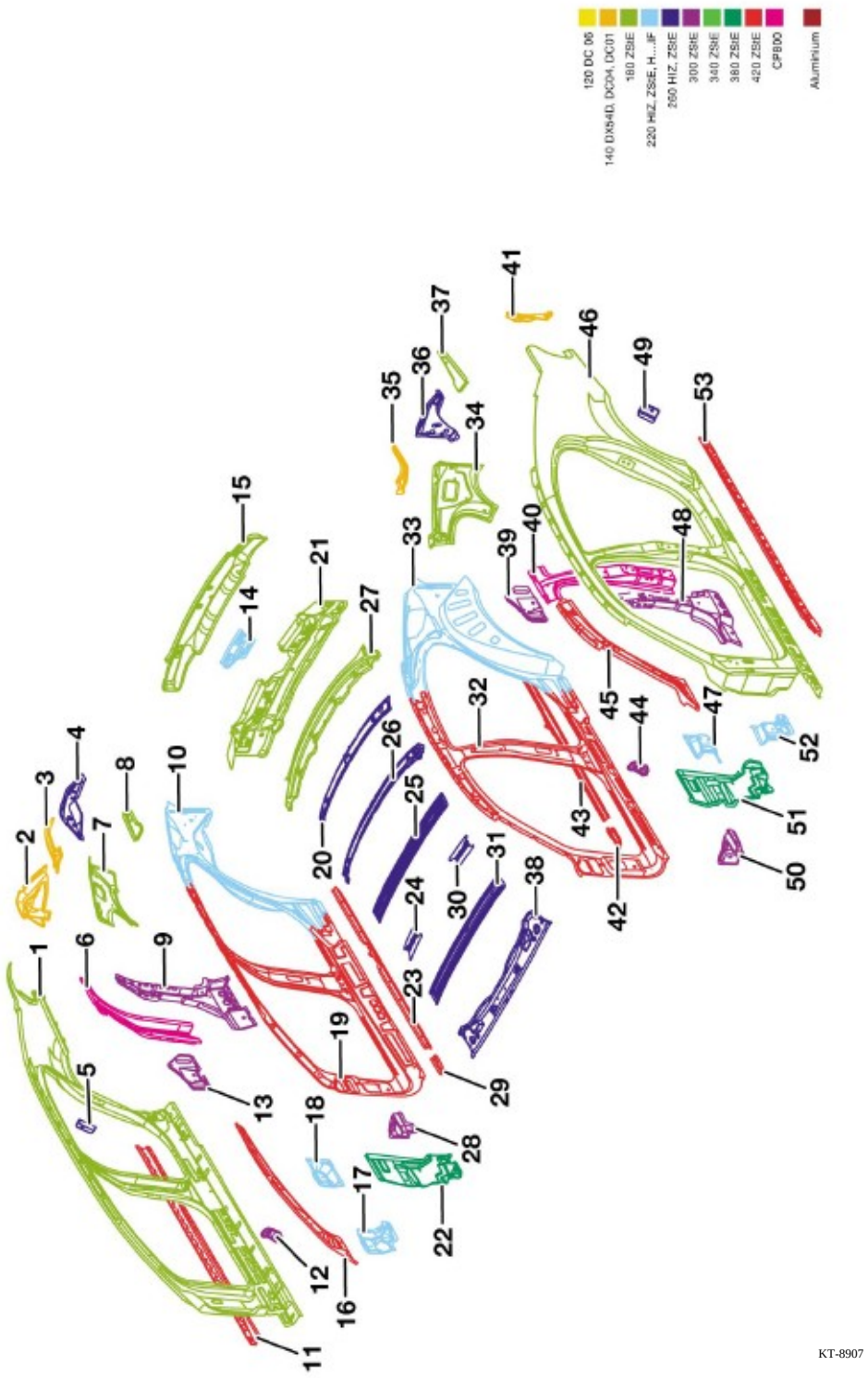

Fig. 10: Exploded view, side carcass

Index	Description
1/46	Side frame, left/right
2/41	Rear-light housing, left/right
3/35	Rain channel, side panel, rear left/right
4/36	Support, extension, wheel arch, rear left/right
5/49	Reinforcement, lock striker, left/right
6/40	Reinforcement, B-pillar, top left/right
7/34	Reinforcement, C-pillar, left/right
8/37	Extension, side panel, rear left/right
9/48	Reinforcement, B-pillar, bottom left/right
10/33	Side frame, inner, rear section, left/right (tailored blanks)
11/53	Attachment, side frame, outer left/right
12/44	Bulkhead plate, entrance, front left/right
13/39	Reinforcement, jack, rear left/right
14	Reinforcement, rear trim
15	Rear trim
16/45	Reinforcement, A-pillar, top left/right
17/52	Reinforcement, hinge, A-pillar, bottom left/right
18/47	Reinforcement, hinge, A-pillar, top left/right
19/32	Side frame, inner, front section, left/right (tailored blanks)
20	Cover, rear-window frame, top
21	Support, rear trim
22/51	Reinforcement, side frame, left/right
23/43	Attachment, side frame, inner left/right
24/30	Rear reinforcement, roof cross-member, left/right
25	Roof cross-member
26	Rear-window frame, top
27	Rear-window frame, bottom
28/50	Reinforcement, A-pillar, bottom left/right
29/42	Attachment, side frame, inner front left/right
31	Roof cross-member
38	Cowl panel, top

The B-pillar is provided with extra strength by two reinforcements (at the bottom and top). The top B-pillar reinforcement is made from CP800 steel.

Note:
In the event of body repairs, it must therefore be borne in mind that only a limited cold reworking can be carried out e.g. at the B-pillar.

The profile section is reinforced at both sills by an additional reinforcement profile section (side-frame attachment), which also serves to accommodate the sill trim.
This profile section offers additional safety in the event of both frontal and side impacts.

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Fig. 11: Reinforcement profile section

In the version with a sunroof, four plastic tubes for water drainage are permanently integrated when the bodyshell is assembled.
These tubes are secured by clips in the A- and C-pillars.

Note:
Removal or replacement is thus not possible in installed state.

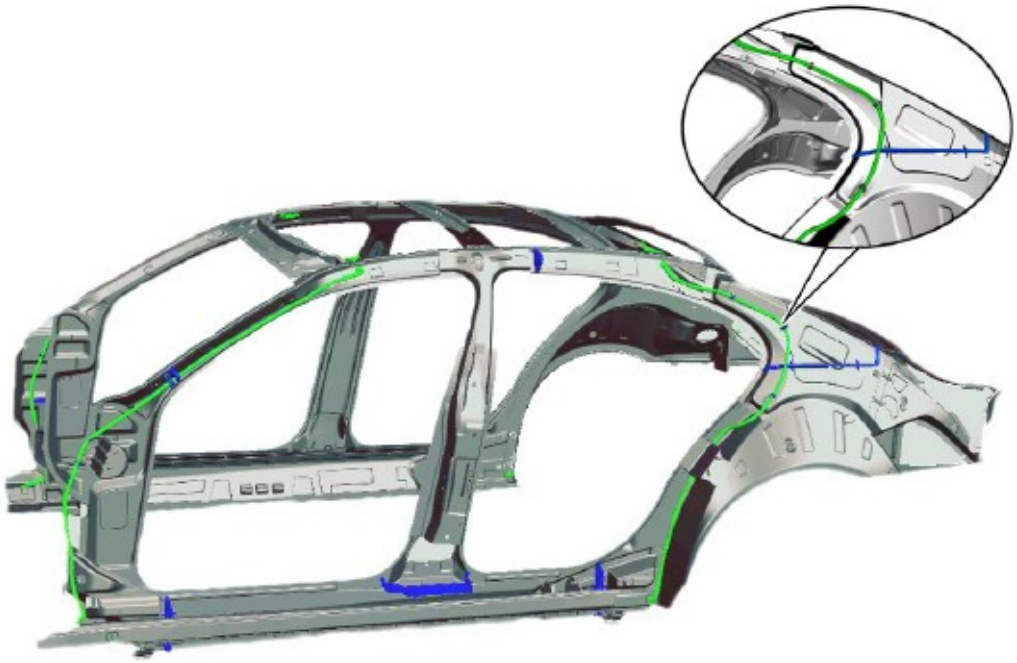

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Fig. 12: Side frame with water drain and cavity acoustic baffles

The water drain tubes are shown in green.

The material and layout of the cavity acoustic baffles shown in blue are the same as those of the E38.

Note:
When body parts are repaired or replaced, the cavity acoustic baffles must be replaced or reconditioned with a sealing compound.

Observe the RA 4100 "Notes on position/ installation/ layout of cavity acoustic baffles."

Inner side frame

The inner side frame are manufactured in one piece from tailored blanks (see section entitled "Tailored blanks").

- Underbody

Bulkhead

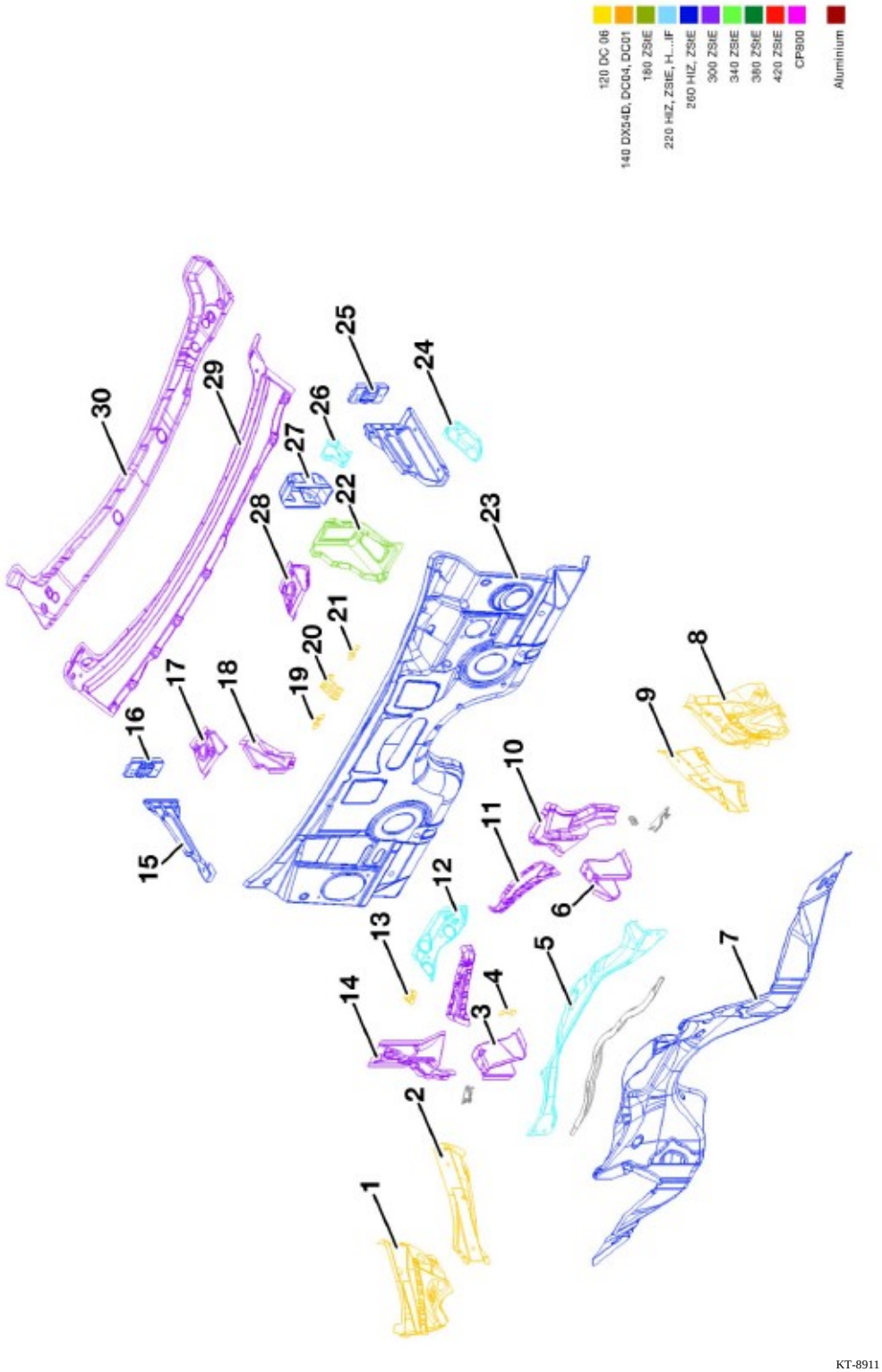

Fig. 13: Bulkhead

Index	Description
1/8	Partition, equipment compartment, left/right
2/9	Reinforcement, partition, equipment compartment, left/right
3/6	Bulkhead plate, bulkhead, left/right
4	Bracket, air conditioner
5	End plate, equipment compartment, middle
7	Support carrier, bulkhead
10/14	Reinforcement, bulkhead, outer left/right
11	End piece, support carrier, bulkhead
12	Mounting, wiper system, middle
13	Holder, cover, cowl panel, bottom
15	Reinforcement, attachment, support tube
16/25	Mounting, attachment, support tube, left/right
17/28	Reinforcement, cross-member, bulkhead, left/right
18	Reinforcement, end piece, bulkhead, upper section, right
19/21	Bracket, air conditioner, left/right
20	Bracket, instrument panel, middle
22	Support, steering column, lower section
23	Bulkhead, lower section
24	Mounting, wiper system, left
26	Bracket, pedal
27	Support, steering column, upper section
29	Cross-member, bulkhead
30	End piece, bulkhead, upper section

The cross-member tube bolted to the instrument panel is located on the inside of the bulkhead. It is supported on the gearbox tunnel.

Floor assembly

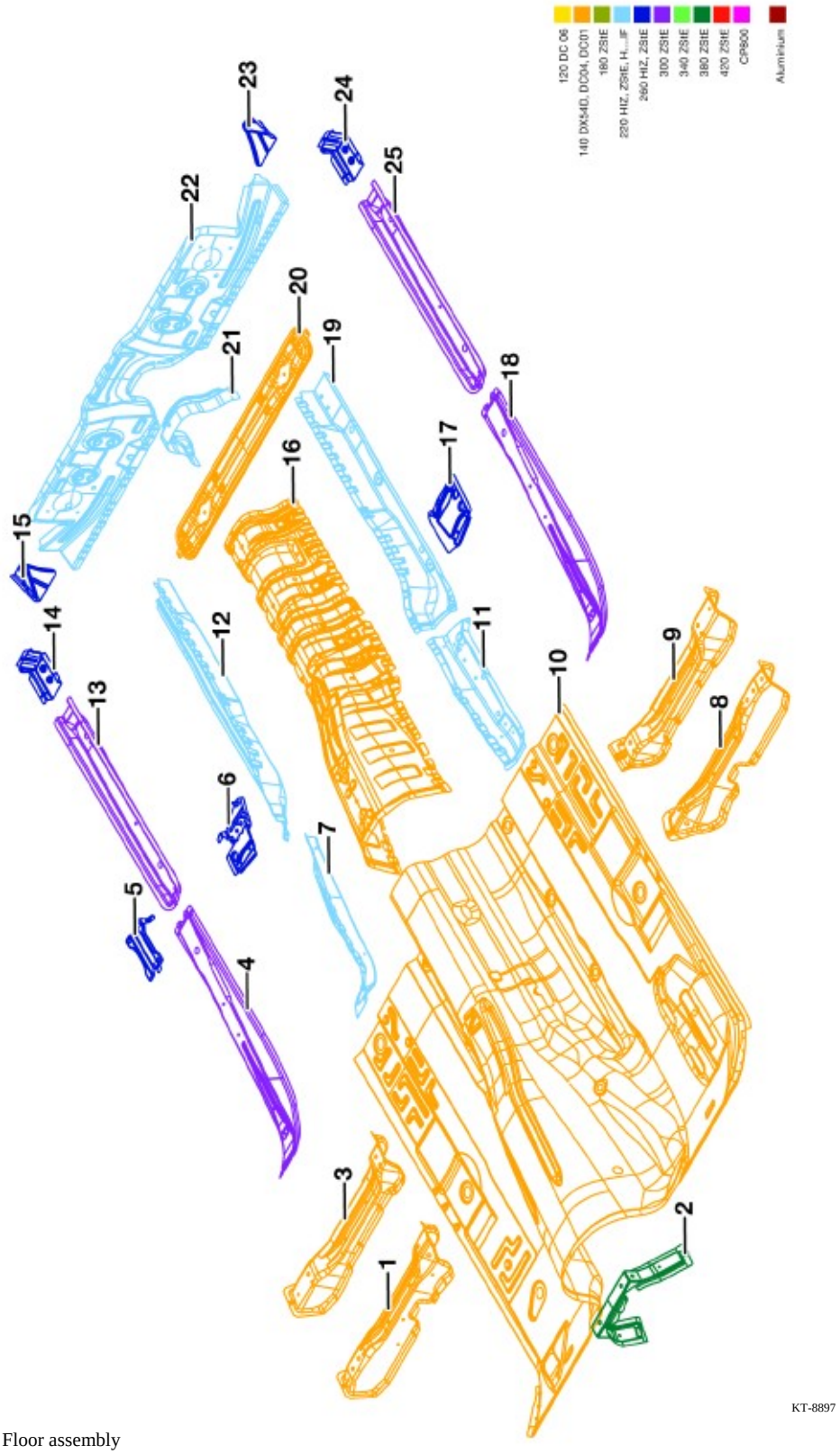

Fig. 14: Floor assembly

Index	Description
1/8	Cross-member, front left/right
2	Mounting bracket, tube, support, steering column
3/9	Cross-member, rear left/right
4/18	Upper section, engine carrier, rear
5	Bracket, satellite, vehicle centre
6/17	Connection, upper section, engine carrier, front left/right
7/11	Mounting bracket, gearbox carrier, front
10	Floor pan, front
12/19	Mounting bracket, gearbox carrier, rear left/right
13/25	Extension, engine carrier, rear left/right
14/24	Connection, extension, engine carrier/cross-member
15/22/23	Cross-member, floor pan, rear
16	Reinforcement, tunnel
20	Connecting carrier, tunnel, rear
21	Reinforcement, cross-member, floor pan, rear

Regardless of the model variant, all the bolts are attached to the floor assembly. Thus no new studs have to be welded on e.g. when components are subsequently installed.

Luggage-compartment partition

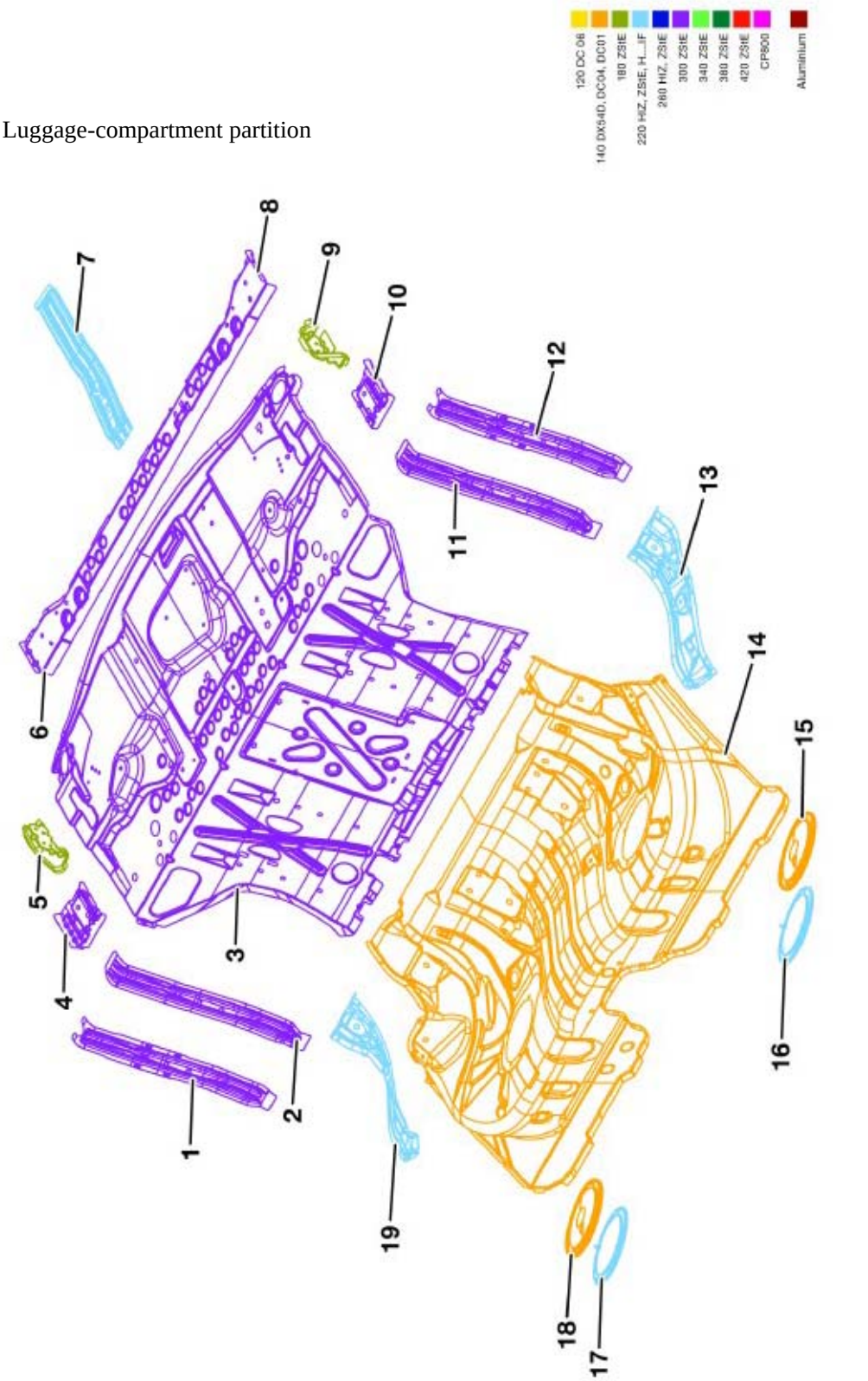

Fig. 15: Floor assembly: luggage-compartment partition

Index	Description
1/12	Reinforcement, outer, for comfort-seat back
2/11	Reinforcement, inner, for comfort-seat back
3	Luggage-compartment partition
4/10	Belt mounting, rear side
5/9	Boot-lid hinge, left/right
6/8	Cross-member, partition, luggage compartment
7	Attachment, belt retractor, rear middle
13/19	Longitudinal reinforcement, floor pan, left/right
14	Floor pan, rear
15/18	Closing cover, floor pan, rear
16/17	Reinforcement ring, left/right

The luggage-compartment partition incorporates a prepunched opening for a ski bag which can be removed as required.

The attachment for the boot-lid shackle hinge is welded to the luggage-compartment partition.

- Rear end

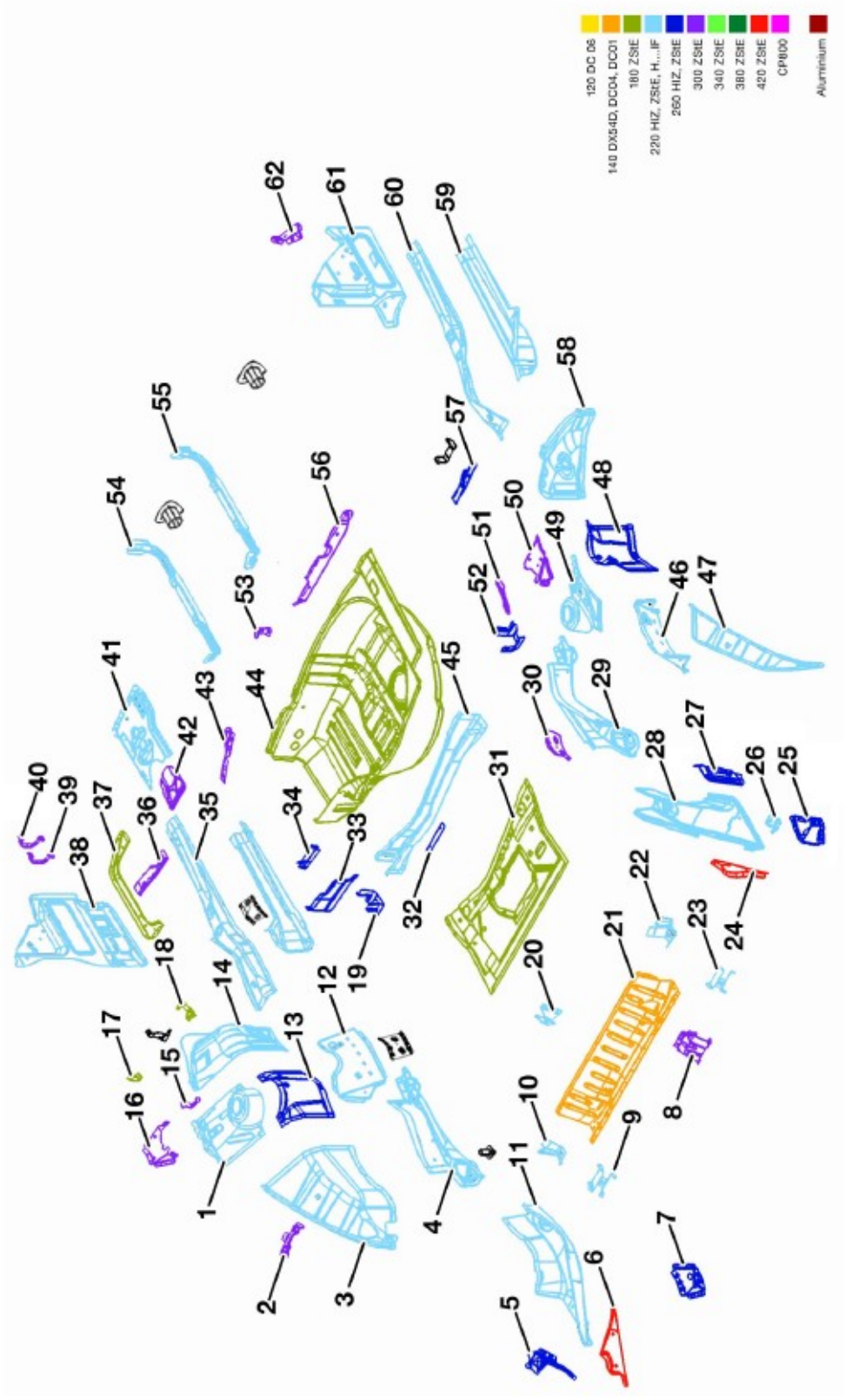

Fig. 16: Exploded view, rear end

Index	Description
1/49	Spring-strut housing, left/right
2	Fixture, expansion tank
3/47	Wheel arch, inner half, front section, left/right
4/29	Carrier, rear-wheel drive, left/right
5/27	Block, belt tensioner, left/right
6/24	End piece, carrier, side left/right
7/25	Support, compression strut, front left/right
8	Reinforcement, ISOFIX, inner
9/23	Reinforcement, ISOFIX, outer
10/22	Reinforcement, cross-member, front
11/28	Carrier, side front left/right
12/46	Support, longitudinal member, left/right
13/48	Spring-strut housing, lower section, left/right
14/58	Wheel arch, inner half, rear left/right
15	Holder, expansion tank
16/50	Compression strut, spring-strut housing
17	Attachment, hydraulic unit
18	Holder, hydraulic unit
19/52	Reinforcement, cross-member, rear left/right
20	Reinforcement, ISOFIX, inner
21	Cross-member, front
26	Attachment, body strut, outer
30	Reinforcement, side
31	Luggage-compartment floor, front
32	Hinge strip
33	End piece, luggage-compartment floor, right
34/57	Cross bulkhead, wheel arch, left/right
35/60	Longitudinal member, rear left/right
36	Strut, longitudinal member, right
37	Luggage-compartment floor, side section, right
38/61	Extension, wheel arch, left/right
39/40	Holder, power module

Index	Description
41	Battery mounting
42	Terminal strip, battery, front
43/62	End piece, rear-light housing, left/right
44	Luggage-compartment floor
45	Cross-member, rear
51	Reinforcement, longitudinal member
53	Holder, 2nd partition, top
54/55	Fixture, air-supply system, left/right
56	Cross-member, luggage-compartment floor, rear
59	Carrier, rear-wheel drive, side rear

Luggage-compartment floor

The longitudinal members are made up of several individual parts. In the event of body repairs, these can therefore be replaced individually.

Bumper cross-member

Like its front counterpart, the rear bumper cross-member is made from aluminium.

In the event of a rear-end impact, the bumper cross-member together with the bumper trim absorbs the impact energy.

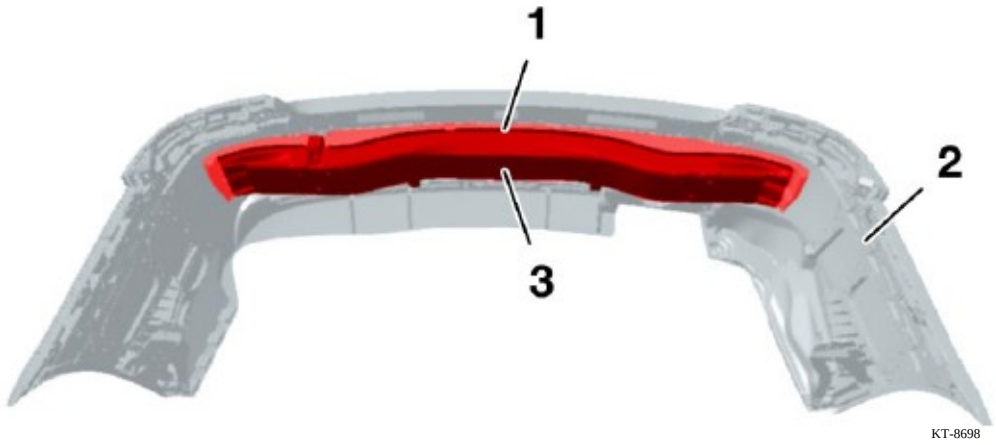

Fig. 17: Structure, rear bumper

Index	Description
1	Polystyrene-foam impact absorber
2	Bumper trim
3	Aluminium bumper cross-member

Note:
Unlike the E38, the rear apron on the E65 is not visible from the outside because it is covered by the bumper trim. This trim should therefore always be removed after a rear-end impact and examined for possible deformations that are not visible from the outside.

- Outer skin panel

Engine bonnet and side panels

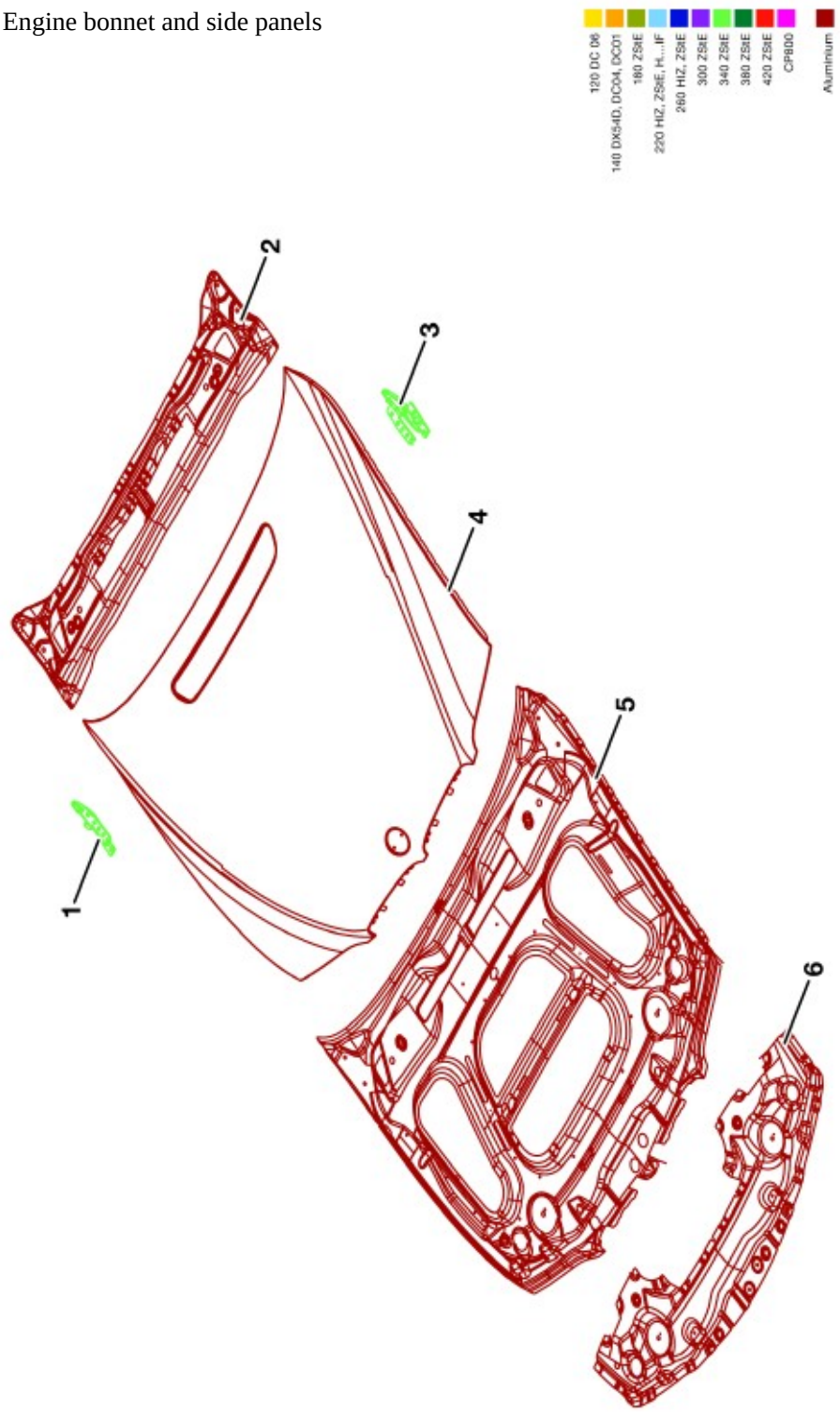

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Fig. 18: Bonnet

Index	Description
1/3	Hinge, bonnet
2	Insert, air routing, bonnet
4	Outer skin panel, bonnet
5	Inner panel, bonnet
6	Reinforcement, lock

In the E65, both the front side panels and all the individual parts of the bonnet are manufactured from aluminium for reasons of weight reduction.

For this reason, wing covers with magnetic fastening elements cannot be used as usual.

The front side panels are bolted to the body.

The front grille is not integrated in the bonnet but rather attached to it by means of screws and clips.

Boot lid

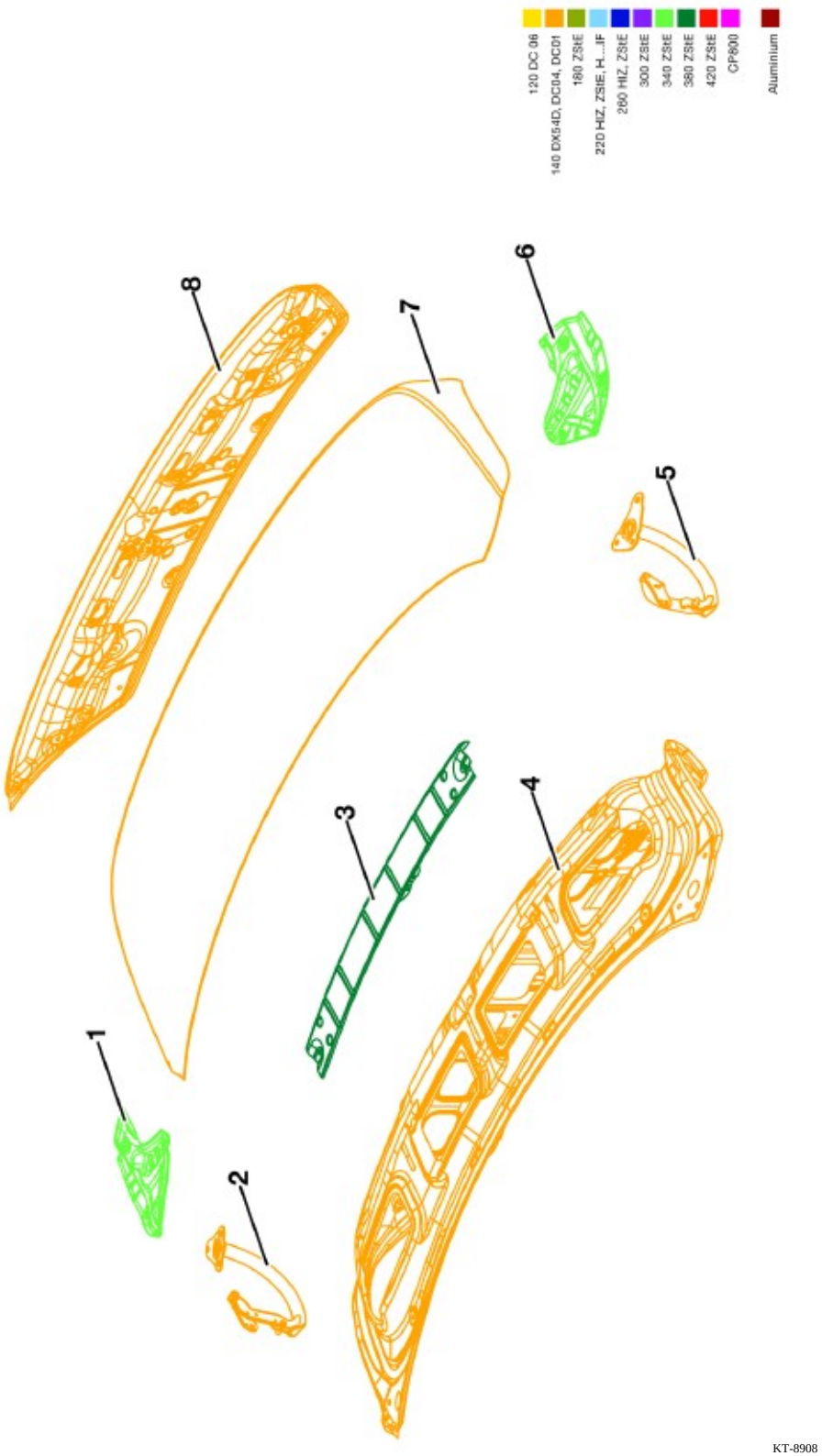

Fig. 19: Exploded view, boot lid

Index	Description
1/6	Reinforcement, hinge, boot lid, left/right
2/5	Hinge, boot lid, left/right
3	Reinforcement, boot lid, outer skin
4	Inner panel, boot lid
7	Outer skin, boot lid, top
8	Outer skin, boot lid, bottom

The boot lid consists of sheet steel with a single shackle hinge.

Because it is attached to the partition between the luggage compartment and the C-pillar, it requires a considerable amount of work to replace the shackle hinge. Several add-on parts and trims must be removed for this purpose.

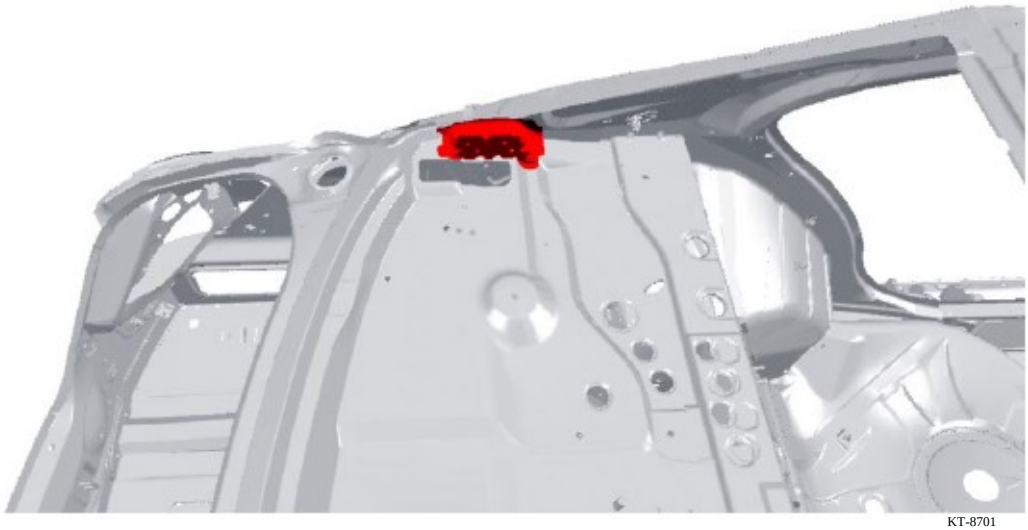

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Fig. 20: Attachment, boot-lid hinge

To remove the hinge shackles, it is necessary to remove the parcel shelf behind the rear window.

Doors

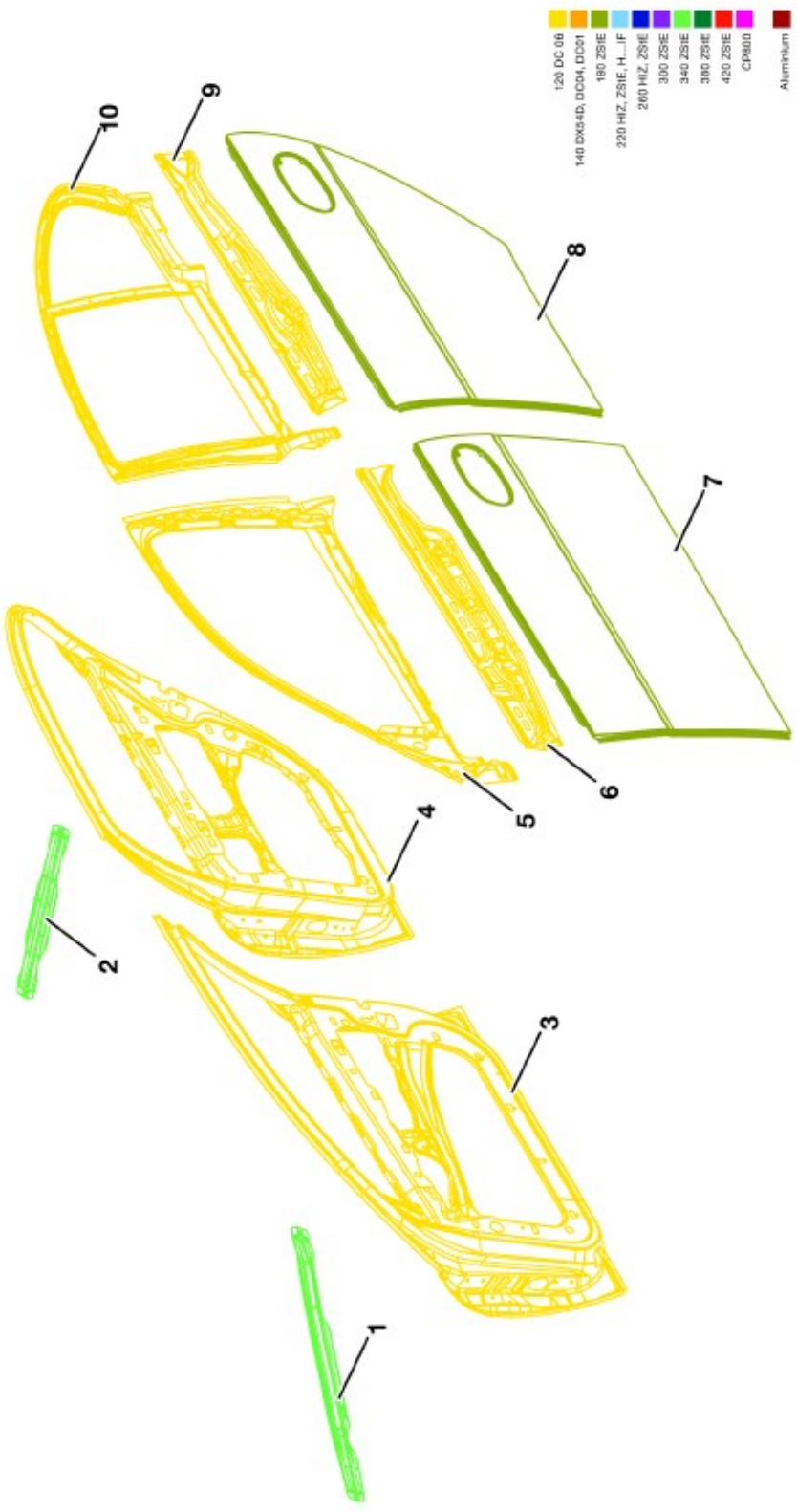

Fig. 21: Exploded view, doors

Index	Description
1	Side-impact beam, front
2	Side-impact beam, rear
3	Inner door panel, front
4	Inner door panel, rear
5	End piece, door, front
6	Reinforcement rail, door, front
7	Outer door panel, front
8	Outer door panel, rear
9	Reinforcement rail, door, rear
10	End piece, door, rear

The inner door panel is clearly thicker in the hinge area (tailored blanks).

Increased rigidity in the hinge area prevents the doors from "hanging."
The doors are thus easier to open after a side impact.

A side-impact beam made from high-tensile steel is bolted to the inside of the door and safety is increased by a removable plastic "crashpad."

Crash safety is positively influenced by spot-weld bonding, reinforcement of the inner panel in the hinge area, the side-impact beam and the crashpads.

Roof

The outer roof skin is laser-welded at the sides to the side carcass.

Joints/gaps

Note:
When replacing add-on parts, it is essential to adjust the gap dimensions, parallelism and displacement in compliance with BMW specifications.

Symmetry has top priority for the overall appearance of the joints/gaps on the components.

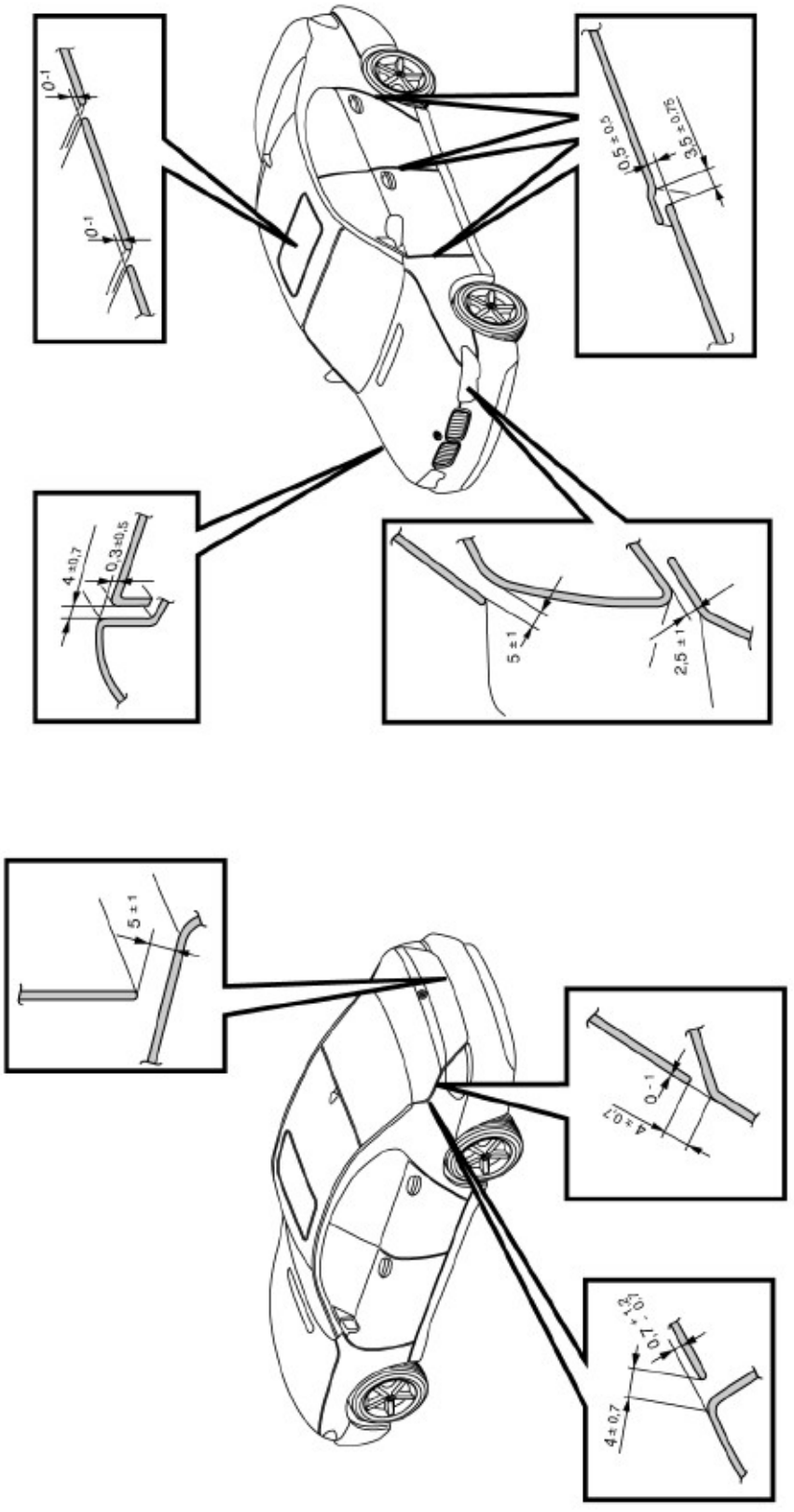

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Fig. 22: Body gap dimensions

Passive safety

- Requirements of structure

Denting susceptibility in the flange area is reduced by the use of bonding agent. This results in stabilization of the carrier profile sections and connections.
Deformation of the passenger cell is significantly reduced by the use of bonding agent.

- Properties of engine carriers

Thanks to the optimal cross-sectional layout, the front engine carriers are designed to absorb the axial forces and thus the energy in the event of a frontal impact. The rear engine carriers serve to support the forces and flexural torques.

The crash beads result in a deformation at defined points.

- Properties of sills

Thanks to the large, buckling-stable cross-section, the sills are designed to absorb the forces in the event of both frontal and side impacts. They also absorb the occurring flexural torques.

- Properties of B-pillar

A B-pillar reinforcement made from CP800 ensures a high degree of safety in the event of a side impact.

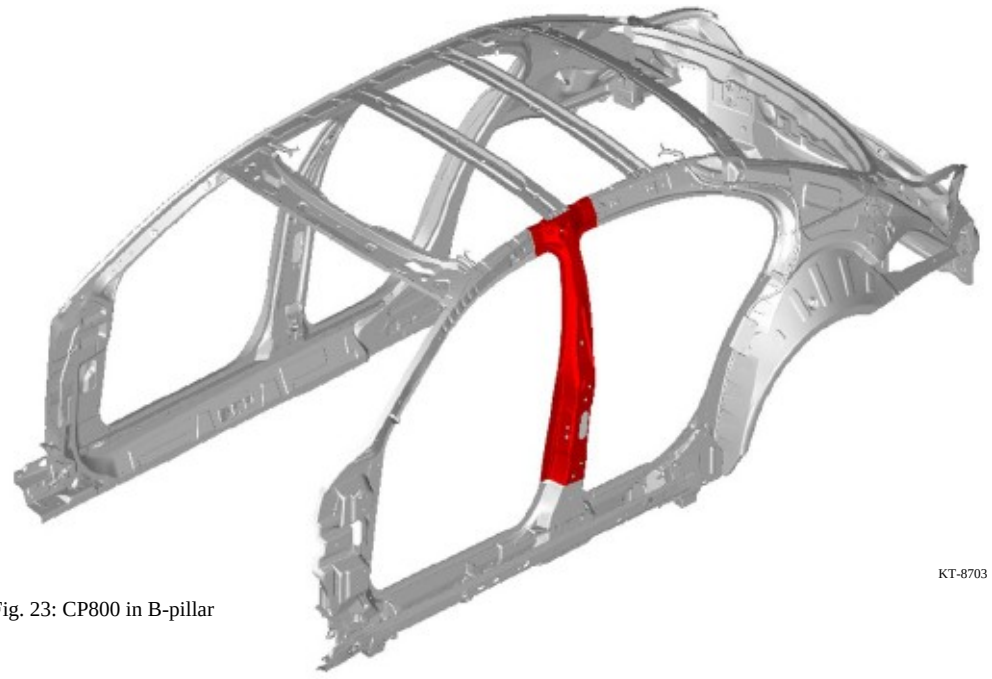

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Fig. 23: CP800 in B-pillar

CP800 steel (complex-phase steel) is the highest-strength steel used in the E65.

Body repairs

- Body measurement

The frame check dimensions can be found in TIS (RA 4100... Frame check dimensions E65).

- Repair requirements

In the event of repairs, the E65/E66 makes great demands on the body-repairing mechanic on account of:

- A variety of electrical and electronic components
- A variety of different materials
- A variety of joining techniques

Suitable body work bays should therefore be in place or if necessary restructured in accordance with the following stand-points:

- Electronic or manual measuring and diagnostic system for body measurement such as e.g. telescopic measuring stick or electronic measuring slides
- BMW-recommended straightening benches (Celette/Car-O-Liner/Car Bench) with suitable sets of straightening attach-ments or measurement data for the E65/E66
- Direct access to TIS information for appropriate and correct body repairs
- An electronic dent puller is recommended for removing dents on sheet steel and aluminum
- Separate set of dent removal tools for surface treatment of aluminium (see note on body repairs)
- Shielded-arc and spot-welding machine with the necessary welding tongs
- Extraction facility for welding emissions (toxic due to zinc plating!) and metal and aluminium dust to avoid contact corrosion
- Lockable metal cabinet for safe storage of sensitive electronic components (e.g. airbag, control units etc.)
- BMW special tools for installation/adjustment work (see BMW Workshop Catalogue)

- Body repairs of high-tensile steel

Due to the increased use of high-tensile steels, it is essential to observe the following points when reworking the body structure:

- The effort exerted in structure reworking increases with the quality of the steels, i.e. with their yield strength
- Heating bearing body parts such as e.g. engine carrier, side carcass or longitudinal member to improve reworking is not permitted!
- Bearing body parts which cannot be returned to their original shapes by "cold-straightening" must be replaced

Failure to comply with these guidelines may result in the loss in original strength of up to 40% and thus an uninsurable and unimputed safety and product-liability risk.
The procedure described in the repair instruction (RA 4100) must be observed without fail.

- Body repairs of aluminium

A separate tool (aluminium set) for the surface machining of aluminium is essential in body repairs!
The inclusion of iron filings in aluminum sheets will result in contact corrosion and paint disruptions.
Conversely, aluminium dust will cause contact corrosion on components made from steel (such as e.g. electronic components and plug connections).

The bumper brackets and the front panel are irreparable on account of their high strength and must be replaced after any deformation.

During repairs, material fatigue caused by forcible material deformation of the aluminium may result in "tearing." This should be avoided as the component in question would have to be replaced.

A replacement should always be considered in the event of heavy deformation or structural buckling.

Further information on repairing aluminium can be found in TIS: RA 4100... (Straightening aluminium parts).

-Body repairs of galvanized sheets

If the zinc coating has been removed within the framework of repair welding, the point of repair must be coated with welding primer before the parts are joined together in order to reestablish corrosion protection.

Further information on repairing galvanized sheets can be found in TIS: RA 4100... (Welding galvanized parts).

- Painting during repairs

The procedure for painting aluminium is the same as that for steel.
When sanding, remember to use separate abrasive paper for steel and aluminium.

Further details on painting can be found in the currently applicable painting manual (see TIS: SI 990195944).