

DRILLING CHASSIS HOLES

REVISION 1

The following document has been prepared by TCS to provide guidance to vehicle modifiers when drilling holes in a heavy vehicle chassis. The information contained in this document is extremely important and must be understood and considered before conducting any modification which involves drilling holes in a heavy vehicle chassis.

These guidelines are supplied without prejudice and TCS will not be held liable for any problems that arise from misinterpretation of these guidelines or from the introduction of new rules after the issue date of these guidelines. The following documents should be read in conjunction with these guidelines:

1. OEM Modification & Body Building Guidelines
(takes precedence over VSB-6 and TCS guidelines)
2. VSB-6 Section H: National Code of Practice for Chassis Modifications on heavy vehicles
(this is largely paraphrased throughout this document but still takes precedence over TCS guidelines)

All modifications must be carried out by a suitably qualified tradesperson in accordance with the relevant Australian Design Rules, Australian Standards and National Codes of Practice. Any uncertainties should be discussed with TCS prior to commencing the modification.

This document has been revised to include Appendix 1 which contains extracts from various OEM Body Building Guidelines for modern vehicles. OEM guidelines must always be sought and reviewed by the modifier (TCS has a vast database and can often provide guidelines for older vehicles) but if OEM Guidelines cannot be found for the vehicle in question, refer to the instructions of VSB6 which are largely summarised below:

The Golden Rules for Drilling New Bolt Holes (from VSB6)

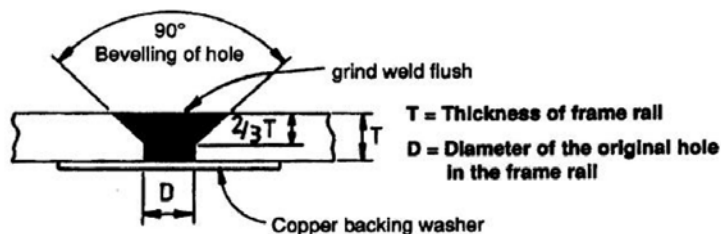
1. Existing bolt holes should be used where possible.
2. All holes **must** be drilled, flame cut holes are **not** allowed.
3. Holes should not be elongated.
4. Hole diameter **must not** exceed bolt diameter by more than 1.0mm
5. Hole centres **cannot** be closer than three times the diameter of the largest hole. If the diameter of the holes is less than 17mm, the centre of the holes must be 50mm apart. This is explained in detail in Figures 1 to 5.
6. Holes should not be drilled in chassis flanges unless it is the practice of the original equipment manufacturer (OEM) to do so. This said, unless you are directly replicating an attachment method of the OEM, TCS recommends that you don't drill holes in chassis flanges at all.
7. **No** holes are allowed within 50mm of a chassis rail join.
8. Unused bolt holes in critical areas such as suspension mounting regions and regions where other components are attached should be **filled with filler bolts** (see page 4). The shank of the filler bolt should be a tight fit within the chassis hole and should extend throughout the depth of the hole.
9. As a non-preferred alternative to Rule 8, holes in non-heat treated chassis rails may be plug welded when it is necessary to drill in close proximity to existing holes. Before plug welding holes, check the OEM guidelines to ensure it is allowed as some manufacturers do not allow it to occur under any circumstances. If holes are to be plug welded, it should be done in accordance with **Figure 7 of VSB-6 Section H**. If filling holes with a diameter greater than 20mm a tight fitting disc should be

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welded into the hole to prevent excess welding. All welds should be ground flush in the longitudinal direction of the chassis rail in accordance with Figure 6 of VSB-6 Section H.

10. Do not use bolts that have their threaded portion against the inside face of the hole, but do ensure that a hardened washer is used between the chassis and the nut so that the nut has sufficient threaded region available on the bolt to be tightly fastened.



This section explains rule 5 in more detail. In Figures 1 to 5:

- blue holes are **existing** chassis holes (OEM or aftermarket)
- green holes are **new** holes
- the centre of any new hole cannot be located in the red region unless the existing hole at the centre of the red circular region is filled (see rule 9 and ensure this is allowed on the vehicle)

If the diameter of any new hole/s **and** the diameter of any existing hole/s is **less** than 17mm, the centre of the new hole/s must be at least 50mm away from the centre of any existing hole/s. All hole diameters are less than 17mm in Figure 1:

Hole diameters less than or equal to 16mm only

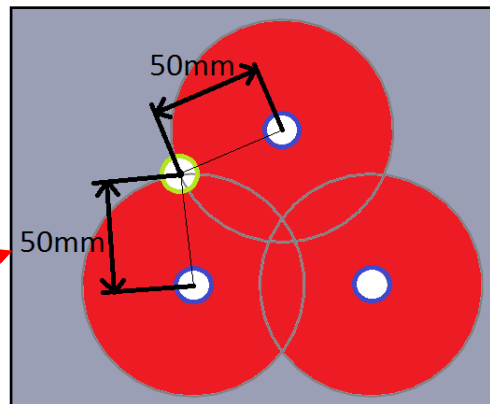


Figure 1

If the diameter of any new hole/s **or** the diameter of any existing hole/s is greater than 17mm, the centre of new hole must be at least 3 times 'D' away from the centre of any existing holes, where 'D' is the diameter of the larger hole. In Figure 2, the existing holes all have the same diameter 'D' which is greater than 17mm and greater than the diameter of the new hole. Note: OEMs are not necessarily bound by the rules contained in this document and may space their holes closer than $3 \times D'$ apart, see page 3 for more details.

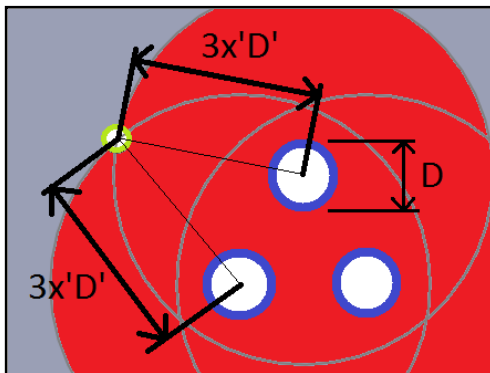


Figure 2

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In Figure 3, the new hole has diameter 'D' which is greater than that of the existing holes.

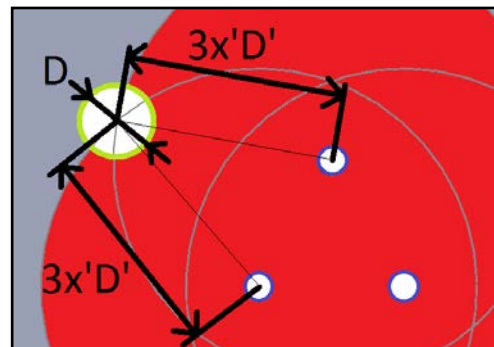


Figure 3

Figure 4 demonstrates how the spacing rules must be applied when multiple hole diameters are present. In this example, the top existing hole is the largest and the new hole must be located at least $3x'D'$ away, but it must also be located at least three times its own diameter away from the smaller existing hole.

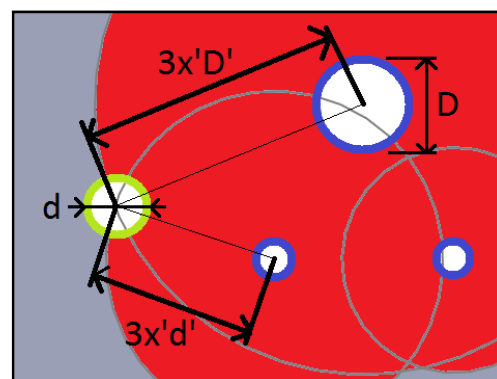


Figure 4

Once a 'new' hole has been drilled, it becomes an 'existing' hole and the same hole spacing rules apply.

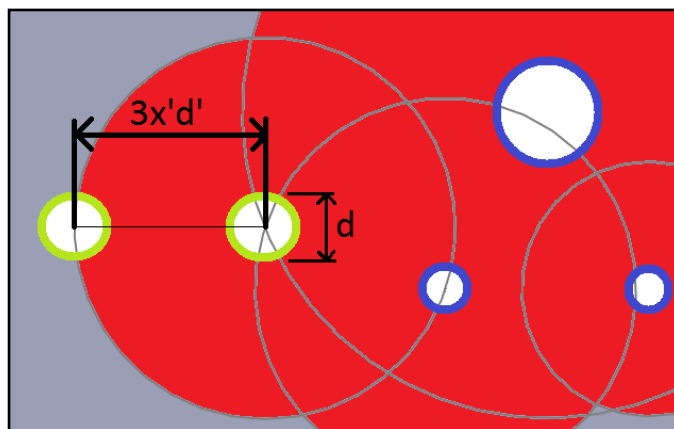


Figure 5

Notes:

It may not be possible to follow these guidelines when completing a modification. Sometimes it is possible to make an exemption to the guidelines **but sometimes it is not**. In the latter circumstances **the modification cannot proceed and will not be certified by TCS**.

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If such an exemption is required, TCS **must** be consulted for approval prior to beginning the modification. Exemptions may be granted if the required hole spacing does not meet these guidelines but is similar to the spacing used by the OEM in a similar scenario, or if there is adequate reinforcement either side of the hole.

As discussed on page 2, the OEM is not necessarily bound by these guidelines if they have proven by calculation or physical testing that their hole spacing is fit for purpose. The ability to conduct such calculations or physical testing often requires a large group of engineers and a substantial budget. Obviously this luxury is not readily available in the case of small scale modifications, so if in doubt about the suitability of hole spacing, TCS will not certify a modification that doesn't meet these guidelines.

NEVER PLUG WELD CHASSIS FLANGE HOLES UNLESS IT IS ABSOLUTELY NECESSARY

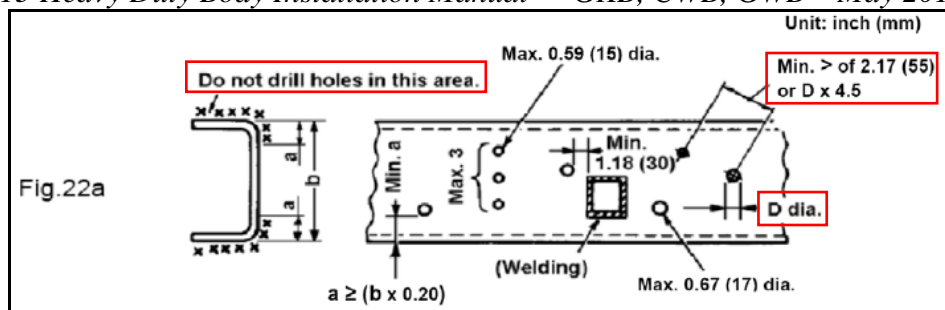
Wherever possible, unused holes in flanges should have filler bolts inserted with hardened washers. The holes in the flange should be reamed and the shank of the filler bolt should be a snug fit inside the hole. Pre-plan your modification to eliminate the need to plug weld flange holes.

Appendix 1 – Extracts of OEM Guidelines

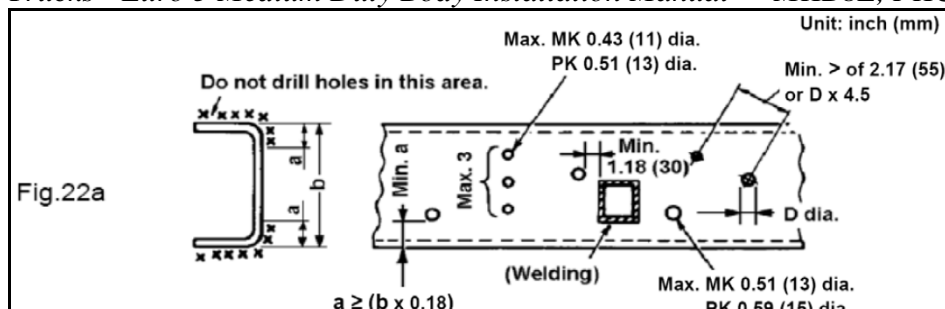
The OEM guidelines relevant to the exact vehicle in question should always be sought and reviewed by the modifier; the following extracts are examples only which have been taken from various OEM guidelines for modern vehicles. Any annotations in red have been added by TCS, all dimensions in brackets are in mm.

UD Trucks

Taken from "GH13 Heavy Duty Body Installation Manual" - GKB, CWB, GWB – May 2010

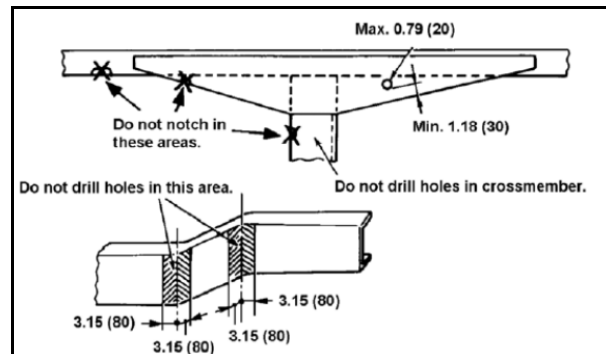


Taken from "UD Trucks - Euro 5 Medium Duty Body Installation Manual" - MKB8E, PKC8E – Feb 2014



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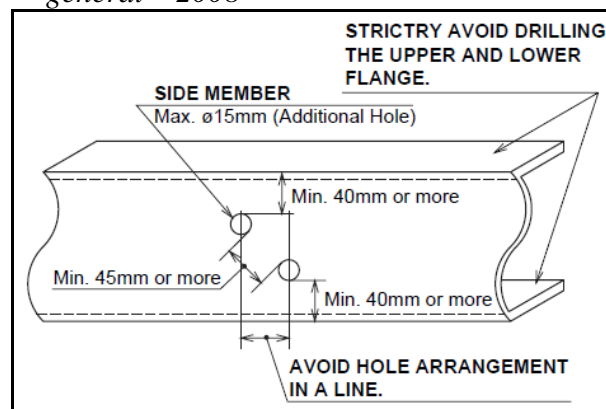
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The figure above applies to heavy duty UD's as well

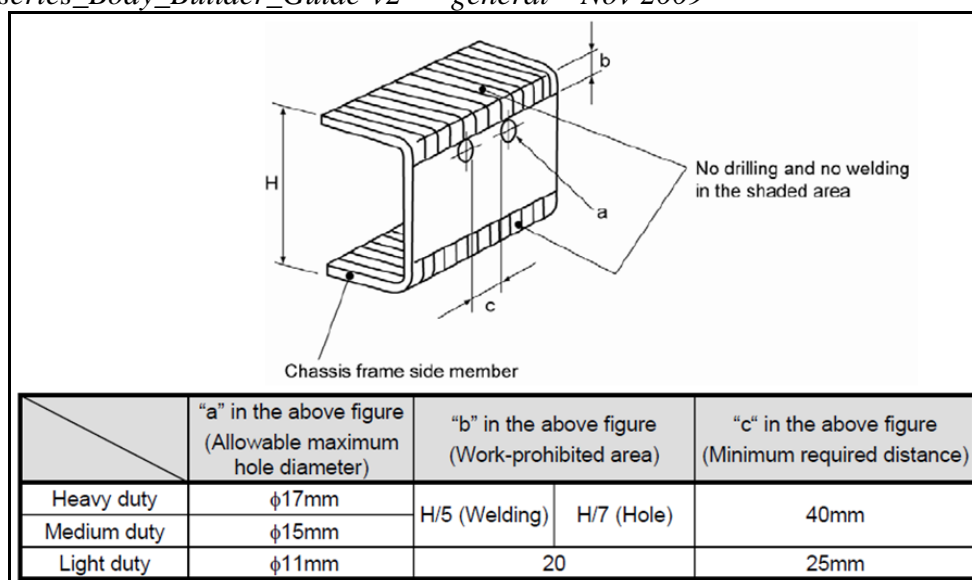
Hino

Taken from "KC-AA201FIG1" – general – 2008



Isuzu

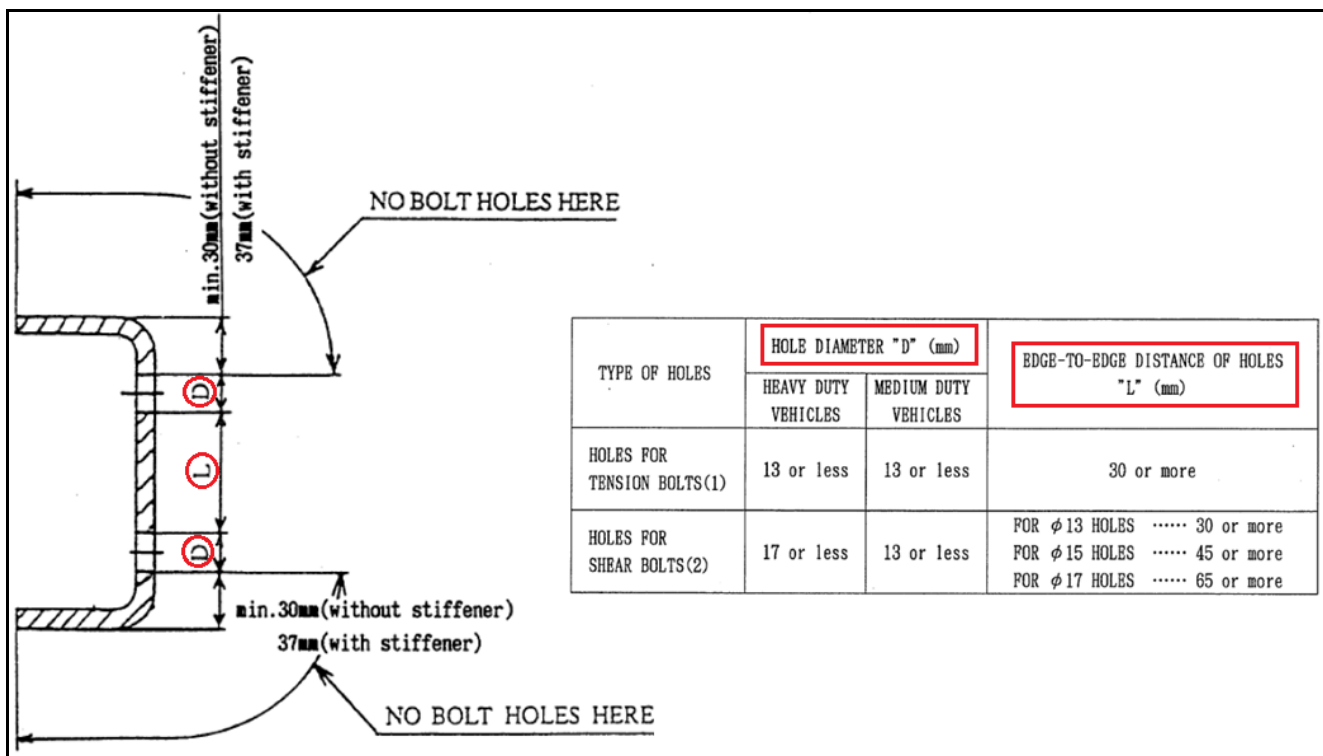
Taken from "F-series Body Builder Guide-v2" – general – Nov 2009



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Fuso

Taken from "Mitsubishi FUSO Body Builders Information for HDT and MDT_20080605" – Medium and Heavy - general – Jun 2008



Freightliner, Mercedes Benz and Sterling

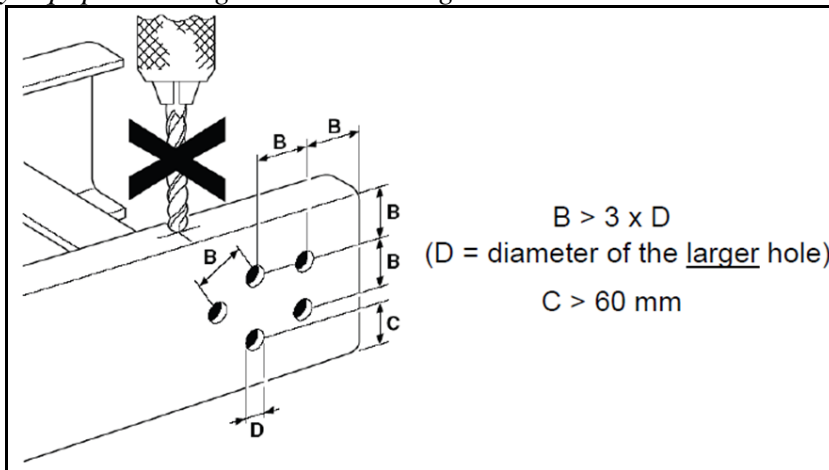
Taken from "Daimler Trucks Body Builders Guide" – General Heavy – Dec 2007

- Material between edge of hole and inside of upper or lower flange must not be less than 50 mm.
- The minimum edge distance between any two holes up to 16 mm in diameter must be 25 mm. For larger than 16mm diameter holes, the minimum edge distance must be 1.5 times the diameter of largest hole.
- No holes will be allowed to exceed 19mm in diameter.

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Kenworth

Taken from "KW Body Equip Mounting Guide 2009" – general – Feb 2009



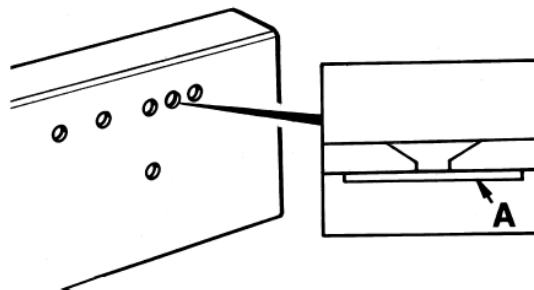
Volvo

Taken from Welding: Welding guide – General – Jun 2006

Plugging holes by welding

Existing holes should be welded closed if new holes are closer than 50 mm, measured from the edges of the holes. Proceed as follows:

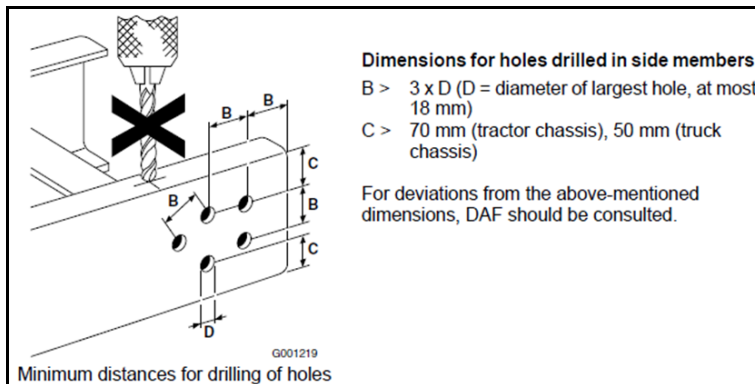
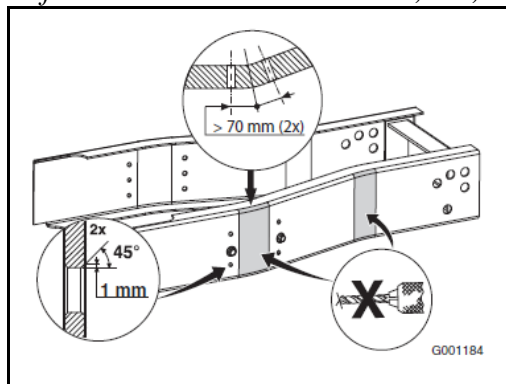
- Chamfer the edge on one side of the hole to 2/3 of the material thickness.
- Position a copper washer A on the inside of the hole.
- Weld with a Ø3.25 mm electrode.
- If the hole has a diameter Ø greater than 20 mm, a chamfered washer should be used when it is welded closed.
- Finish the job by additional welding from the inside.



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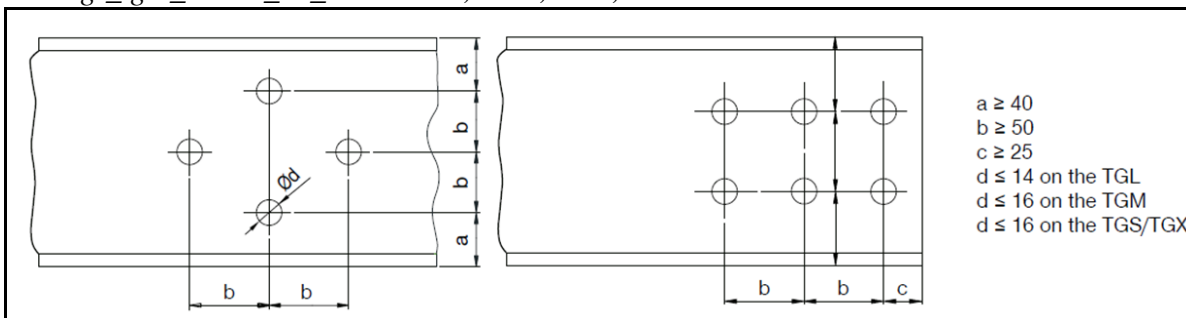
Taken from "BBG201222EN" – LF, CF, XF105 – 2012



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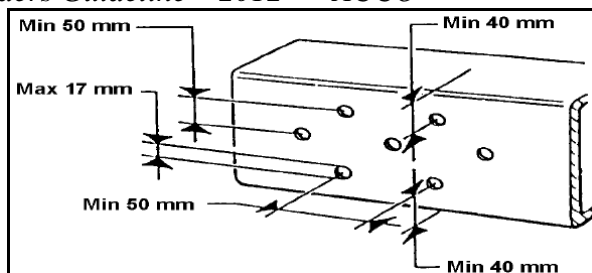
MAN

Taken from "tgl_tgm_e2014_v1_en" – TGL,TGM, TGS, TGX – 2014



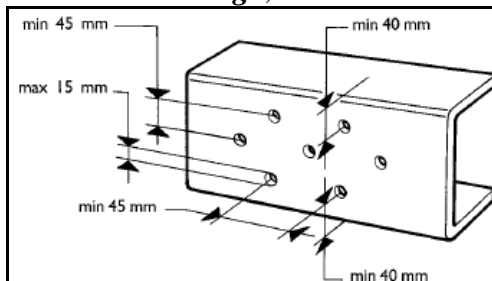
Iveco

Taken from "ACCO Body Builders Guideline – 2012" – ACCO

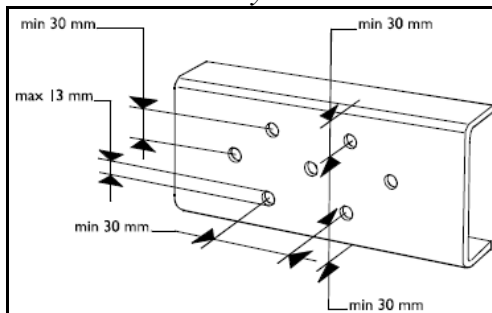


Taken from "Astra HD9 Body Builders Guideline" – Astra HD9

(The same diagram can also be found in the Eurocargo, Stralis and Trakker guidelines)



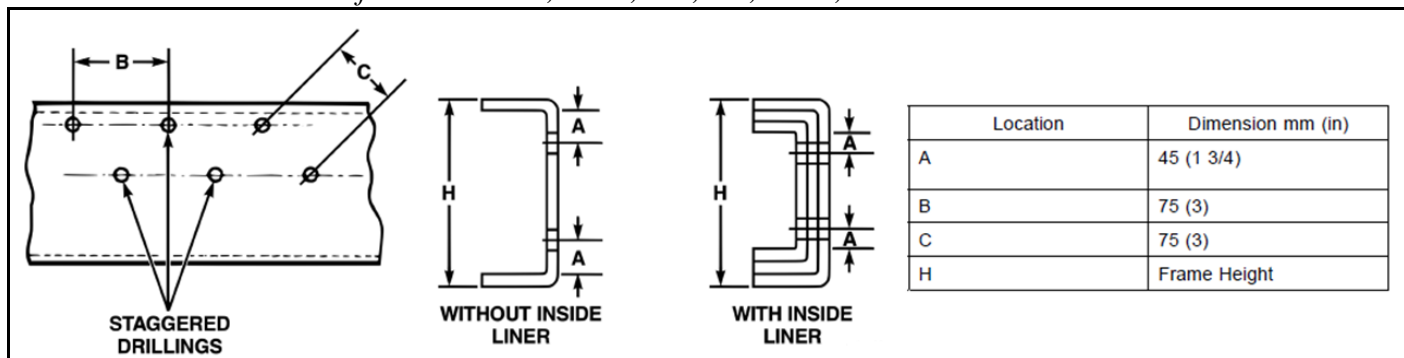
Taken from "Daily 2012 Body Builders Guide" – Daily 4x2



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Mack

Taken from "PV776-89133506 body installation" – CMM, CMH, CLX, CSM, CXX – Nov 2013 and
"PV776-88958262 chassis frame" – CXU, CHU, GU, TD, MRU, LEU – Feb 2010



Scania

Taken from "bwm_0000380_01", "bwm_0000410_01", "bwm_0000448_01" – general – 2014

Permissible hole pattern in frame side member

Use the pre-drilled hole patterns in the frame side members if possible. Drill new holes only according to the described hole patterns and measurement instructions. See illustration.

The illustration shows the minimum distance between the hole and the flange and between the holes. Maximum hole diameter in the frame side member between front and rear axle is approx. 30 mm.

- A shows the minimum distance between hole and beam flange. The dimension should be $3 \times D$, but must not be less than 40 mm. The exception is single-frame tractors, where the distance must not be less than 80 mm.
- B should be $3 \times D$, but must not be less than 50 mm.

Weld up existing holes if the new holes must be drilled nearer than that which is permitted.

Filling welding holes

If holes are to be filled follow the work description below.

1. Bevel the hole.
2. Clamp a copper plate (1), for example, to the inside of the side member with a screw clamp or similar.
3. Weld the hole closed (2).
4. Remove the copper plate and finish-weld on the inside of the side member.
5. Grind the weld flat on both sides.
6. Apply anti-corrosion treatment to the area.

For larger holes, a washer can be used as filler when filling welding.

