

Chapter 5

CHASSIS MODIFICATION

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1. GENERAL CAUTIONS

Prior to modifying the chassis frame, be certain the application and installation of the body type is suitable for the model.

Chassis frame modifications (including changes to the rear overhang) should be kept to the absolute minimum since there is a danger that they will reduce the frame strength and service life of the vehicle and impair the vehicle's safety and running performance.

If such modifications are unavoidable, cautions and standards should be strictly adhered to and the modifications should be kept to the absolute minimum.

The original Gross Axle Weight Rating (GAWR) and Gross Vehicle Weight Rating (GVWR) must not be exceeded when a chassis frame has been modified.

When cutting the side rails, the vehicle should be placed on a flat floor and the modification should be performed while supporting the side rails on both sides of the modification.

When modifying chassis frame and tightening modified parts, metric sized bolts and nuts complying with SAE J1199 class 10.9 should be used.

When tightening a parts to be used bolt and nut method to the chassis frame, you must tighten the nut, not to bolt, in order to get proper regulation axial tension. So there is a no chance that a bolt and nut will come loose.

After the chassis frame has been modified, checks should be made as to whether the modifications have been performed as required by the procedures and cautions referred to herein.

After body installation a steering alignment should be carried out.

2. CHASSIS FRAME PROPERTIES

When a chassis frame is to be modified, the material used for the modification must be the same as that of the original chassis frame.

Use of non-specified material will impair the vehicle's service life and safety and lead to trouble.

The material of the original chassis frame is specified in following table.

FRAME SPECIFICATION

"B"	Model	Wheelbase designation mm (in.)	3,861 (152)	4,191 (165)	4,445 (175)	4,597.4 (181)	4,749.8 (187)	4,978.4 (196)	5,207 (205)	5,384.8 (212)	5,511.8 (217)	5,969 (235)	6,426.2 (253)	6,883.4 (271)	7,112 (280)	7,340.6 (289)	7,569.2 (298)	7,721.6 (304)	
		NH							●		●	●							
	Frame material		Hot Rolled High Manganese Boron Steel																
	Minimum yield strength		87.8 kg/mm ² (120000 PSI)																
	Section modulus (one side)		2.56 x 10 ⁵ mm ³ (15.64 in ³)																
	Resisting bending moment (one side)		2162550 kgf·cm (1877214 in-lbs)																
Width of frame assembly		865.8																	

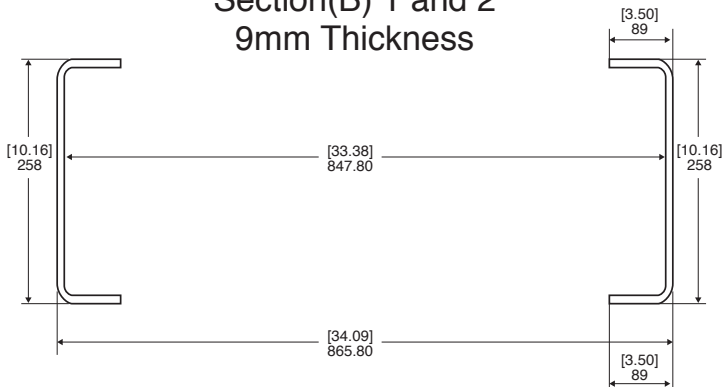
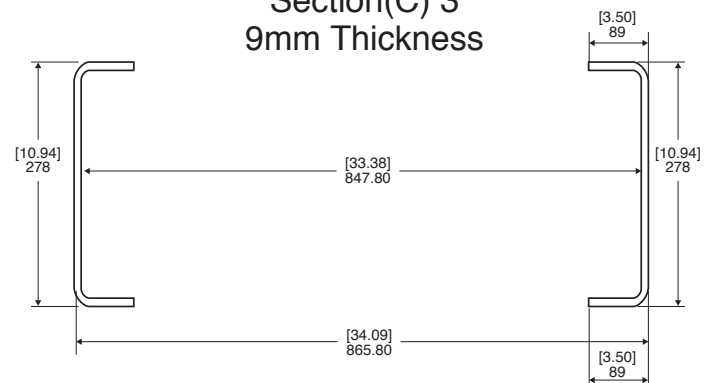
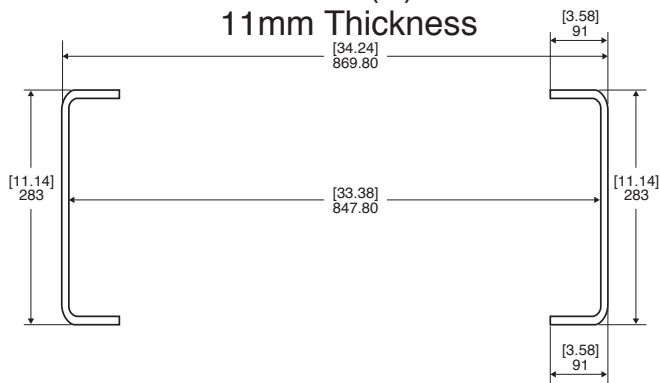
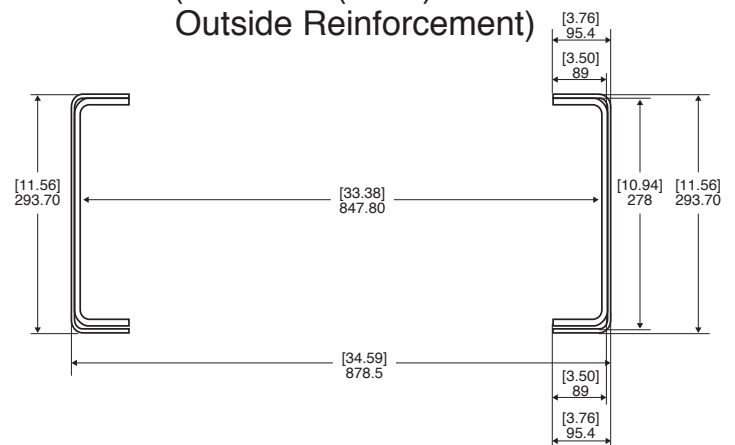
"C"	Model	Wheelbase designation mm (in.)	4622.8 (182)	4927.6 (194)	5435.6 (214)	5918.2 (233)	6629.4 (261)	6731 (265)	6985 (275)	7137.4 (281)									
		NM				•													
	Frame material		Hot Rolled High Manganese Boron Steel																
	Minimum yield strength		87.8 kg/mm ² (120000 PSI)																
	Section modulus (one side)		2.85 x 10 ⁵ mm ³ (17.41 in ³)																
	Resisting bending moment (one side)		2407988 kgf·cm (2090268 in·lbs)																
	Width of frame assembly		865.8																

"D"	Model	Wheelbase designation mm (in.)	3,861 (152)	4,191 (165)	4,445 (175)	4,597.4 (181)	4,749.8 (187)	4,978.4 (196)	5,207 (205)	5,384.8 (212)	5,511.8 (217)	5,969 (235)	6,426.2 (253)	6,883.4 (271)	7,112 (280)	7,340.6 (289)	7,569.2 (298)	7,721.6 (304)
		NH											●	●		●		
		Wheelbase designation mm (in.)	4622.8 (182)	4927.6 (194)	5435.6 (214)	5918.2 (233)	6629.4 (261)	6731 (265)	6985 (275)	7137.4 (281)								
		NM					●	●										
		Frame material	Hot Rolled High Manganese Boron Steel															
	Minimum yield strength	87.8 kg/mm ² (120000 PSI)																
	Section modulus (one side)	3.57 x 10 ⁵ mm ³ (21.77 in ³)																
	Resisting bending moment (one side)	3008802 kgf·cm (2611808 in-lbs)																
	Width of frame assembly	869.8																

"E"	Model	Wheelbase designation mm (in.)	3,861 (152)	4,191 (165)	4,445 (175)	4,597.4 (181)	4,749.8 (187)	4,978.4 (196)	5,207 (205)	5,384.8 (212)	5,511.8 (217)	5,969 (235)	6,426.2 (253)	6,883.4 (271)	7,112 (280)	7,340.6 (289)	7,569.2 (298)	7,721.6 (304)		
		NH																		
		Wheelbase designation mm (in.)	4622.8 (182)	4927.6 (194)	5435.6 (214)	5918.2 (233)	6629.4 (261)	6731 (265)	6985 (275)	7137.4 (281)										
		NM	●	●	●	●	●	●	●	●										
	Frame material		Hot Rolled High Manganese Boron Steel																	
	Minimum yield strength		87.8 kg/mm ² (120000 PSI)																	
			Insert								Outsert									
	Section modulus (one side)		2.85 x 10 ⁵ mm ³ (17.41 in ³)									2.38 x 10 ⁵ mm ³ (14.53 in ³)								
	Resisting bending moment (one side)		4414459 kgf·cm (3831996 in-lbs)																	
	Width of frame assembly		878.5																	

Section Outside Dimensions

Unit : mm (in.)

Section(B) 1 and 2
9mm ThicknessSection(C) 3
9mm ThicknessSection(D) 4
11mm ThicknessSection(E) 5
(Section 3 (9mm) + 6.35
Outside Reinforcement)

3. CHASSIS FRAME DRILLING

Drilling of the chassis frame greatly affects strength and if such operations are executed improperly, the frame might be seriously damaged. When drilling the chassis frame, follow the instructions given below carefully.

Original holes in the chassis frame must not be drilled again.

Drilling holes through the upper and lower flanges, must be strictly avoided.

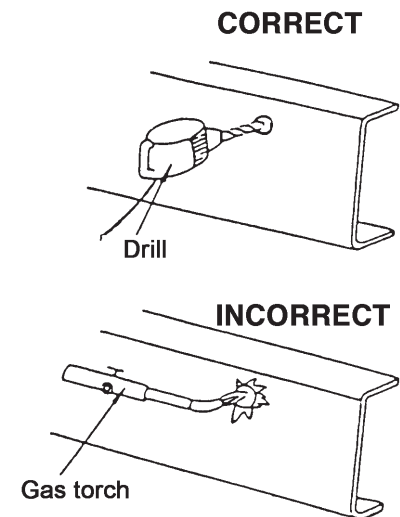
Drilling holes through the side rail changing the exterior shape, or changing the section modulus such as the inner stiffener is fitted, must be strictly avoided.

Drilling holes through the cross members must be strictly avoided.

Drilling holes near the spring brackets and the maximum bending moment sections of the side rail must be strictly avoided.

When drilling holes, brake hoses or nylon tubes, brake pipes, and electrical wiring should be protected against damage.

Be sure to use a drill in making holes. Never use a gas torch or the like.

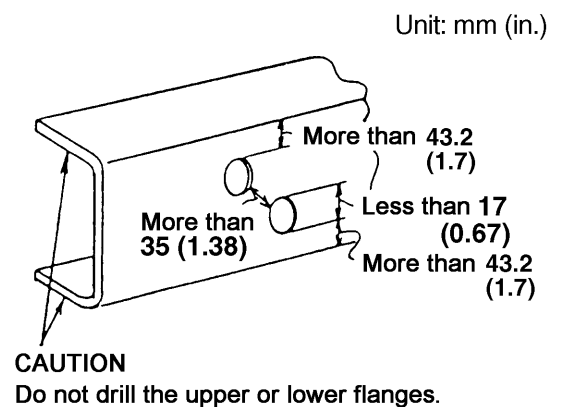


To avoid increasing the temperature of a drill, use an appropriate drill having a tip angle to suit the material drilled.

The diameter of the hole in a side rail must be less than 17 mm (0.67 in.). Hole diameters must not exceed bolt diameters by more than 1 mm (0.039 in.).

When drilling holes through the web, they should be more than 43.2 mm (1.7 in.) away from the upper or lower edge of the web. Distance between holes should be more than 35 mm (1.38 in.).

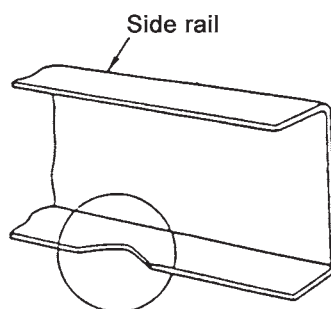
Holes should be deburred after drilling.



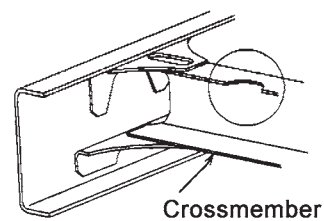
4. FLANGE CUTTING

Never cut off the side rail flange and crossmember for the reasons of a body mounting.

INCORRECT



INCORRECT



5. CHASSIS FRAME WELDING

General Warning

Welding the chassis frame greatly affects its strength, and if such operations are executed improperly, the chassis frame can be seriously damaged.

When welding the chassis frame, carefully follow the instructions bellow.

- Welding the wheel base of the chassis frame is prohibited.
- An experienced professional should always perform the welding to assure the following welding conditions since a poor welding job on the chassis frame can cause damage.
- Before and during welding, make sure that there are no flammable materials such as oil, rags around working area.
- When arc welding, ventilate and/or wear an antitoxic mask against noxious gas.
- To prevent burns, electric shock, and gas poisoning during arc welding, wear a hard hat, apron, antitoxic mask, safety goggles, arm coverings, leg coverings, safety boots, and gloves.
- Other basic cautions on welding to perform it before and after, refer to Chapter 4. Truck Body and Special Equipment Installation Precautions.

Welding Conditions

Consult the table below for welding conditions.

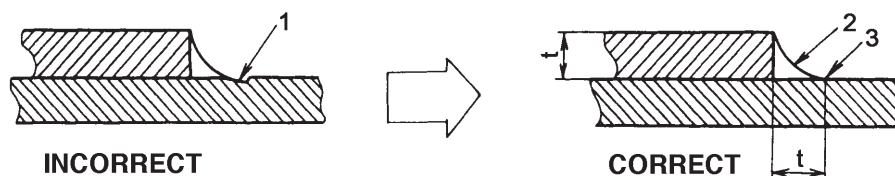
WELDING CONDITIONS

		Electric current (Unit: A)					
	Rod dia. ϕ	3.2 mm {0.126 in.}		4 mm {0.157 in.}		5 mm {0.197 in.}	
	Welding position	Flat	Vertical overhead	Flat	Vertical overhead	Flat	Vertical overhead
Mechanical property of weld metal & rod	Weld Metal (Hot roll plate) Tensile strength, 621 MPa {63 kgf/mm ² , 89.605 lbf/in. ² } Welding Rod Tensile strength: 539 MPa {55 kgf/mm ² , 78.228 lbf/in. ² } Illuminate type (JIS D8016 AWS E8018) Coated electrode	100 - 150	90 - 140	140 - 200	130 - 180	190 - 270	—
	Weld Metal (Hot roll plate) Tensile strength, 538 MPa {55 kgf/mm ² , 78.228 lbf/in. ² } Welding Rod Tensile strength: 490 MPa {50 kgf/mm ² , 71.116 lbf/in. ² } Illuminate type (JIS D4301 AWS E6019) Coated electrode	90 - 140	80 - 130	141 - 190	110 - 160	180 - 250	—

[NOTE] • Diameter of welding rod ϕ 3.2 mm {0.126 in.} or ϕ 4 mm {0.157 in.} - plate thinner than 5 mm {0.197 in.}
 • Diameter of welding rod ϕ 4 mm {0.157 in.} or ϕ 5 mm {0.197 in.} - plate thicker than 6 mm {0.236 in.}

Welding Bead Shape

Make sure that the shape of the welding beads corresponds to the shape illustrated below.



1. Under-cut
2. Concave welding
3. This area should be smooth and free from under-cuts.

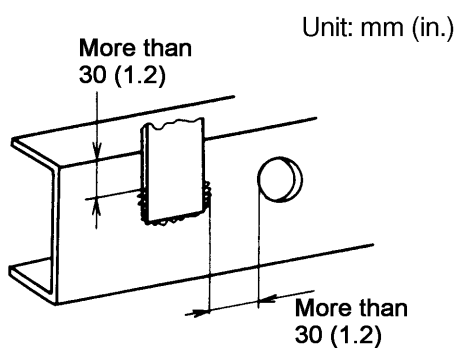
Avoid the following defects in welding beads:

Deposited Metal Cracking 	Toe Crack 	Blow Hole
Slag Inclusion 	Under cut 	Poor Penetration

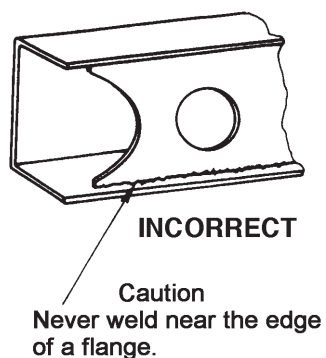
In order to reduce the stress caused by welding, the welding length should be as short as possible and the welding volume should be kept at a required minimum to secure the strength. Avoid concentration or proximity of welding joints as far as possible. Don't carry out the welding work on edges or bent portions as it demands a considerable welding skill.

Welding Positions

Side rail web welding must be conducted at least 30 mm (1.2 in.) away from the edges of the side rail or any hole.



Never weld near the edge of a flange.



In welding, make sure that there is no undercut or the overlap of the bead and a pin hole.

6. REAR OVERHANG EXTENSION

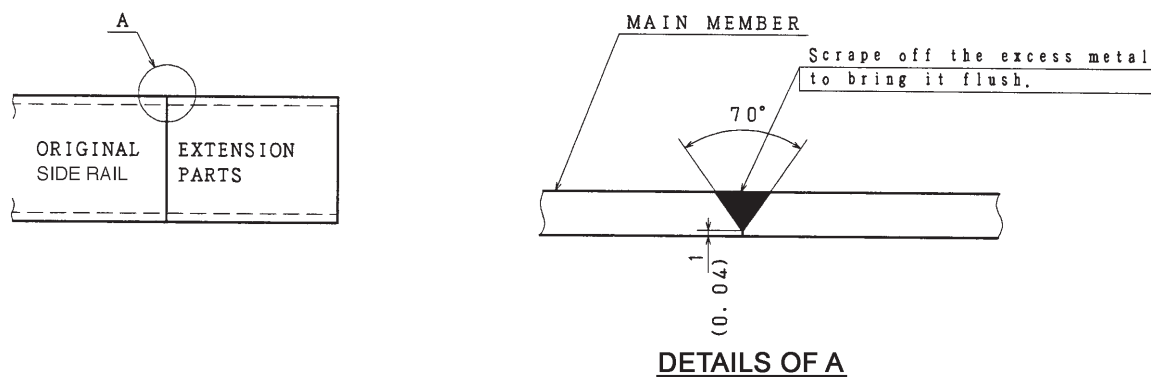
Rear overhang extension should be minimized since extension can reduce the service life of the vehicle and impair its safety.

The material and dimensions of the extension rail must be the same as those of the original side rail.

The extension rail should be aligned with the original side rail.

- Rear overhang extension
(less than 200 mm (7.9 in.))

Unit : mm (in.)



7. WHEELBASE MODIFICATIONS

Modification of the wheelbase is prohibited.

8. PROPELLER SHAFT MODIFICATION AND ALTERATION

Hino Engineering does not support customer modification of The propeller shafts. Modifications can affect driveline angles and torsional accelerations. This can affect performance and durability of the driveline.

9. SERVICE BRAKE MODIFICATIONS

Do not Modify the Brake System

The brake system is the most important safety component of the vehicle and you must never modify it when mounting a body or equipment.

If you must modify the piping of the brake system in order to make other modifications to the chassis during body or equipment mounting (moving the fuel tank, etc.), please contact HMC or Hino authorized dealer and follow the advice that they provides.

Compliance to CMVSS

This incomplete vehicle, when completed as a truck, will conform to CMVSS 121, Air Brake Systems or CMVSS 105, Hydraulic Brake, provided that;

- Neither the GVWR nor the GAWR is exceeded.
- No alterations are made to suspensions, foundation brake, wheel equipment or brake control system.
- The height of center of gravity from the ground to the completed vehicle with pay load should not exceed 1778mm (70in.) for all models, and no alteration is made to any brake system component.

General Points of Brake System

Brake System Specifications

Hino vehicles are equipped with an assisted brake system that is matched to the size of the vehicle to allow the driver to operate the brakes in safety and comfort.

The table below shows, in outline, how brake systems are matched to chassis models.

CHASSIS MODEL	BRAKE SYSTEM
ALL	FULL AIR BRAKE

If body equipment design means that you need to take power from the brake system such as air to control transmission P.T.O. provided by body or equipment manufacturer, be sure to make a thoroughly study of the basic brake system before performing these modifications.

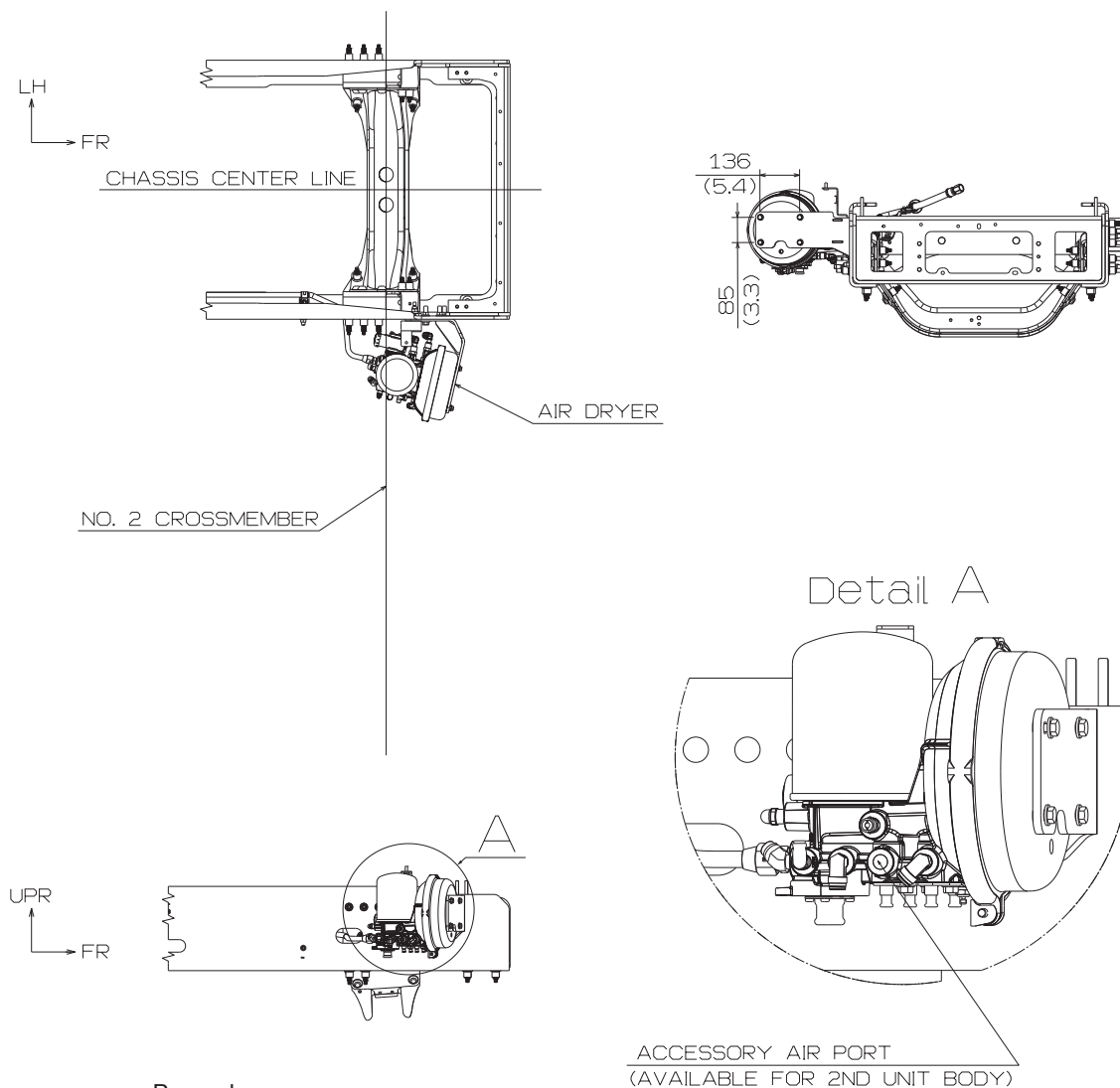
The air dryer offers available ports to support air needs for second unit bodies. The air tanks do not include additional bosses for use of second unit bodies.

MODEL : ALL

Refer to the following figure.

Be sure to install a protection valve in the added air line.

Unit : mm (in.)



Procedure

All Suspension Model

- Use vacant center port.
- Remove the plug(s).
- Install the connector (NPTF 1/4in.).

Customer and Body Builder will be responsible for modification of air tanks to support body builds.

Brake Piping Used in The Hino Chassis

Steel Piping Used in the Hino Chassis

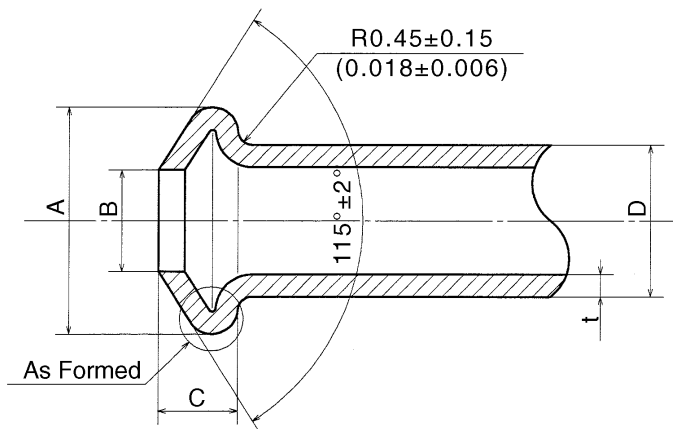
The table below shows the material of the piping used in the Hino chassis and the configuration of the flare of each type of pipe.

Unit: mm (in.)

Nominal diameter D	Flare configuration					Remarks
	A	B	t	C	S	
4.76 (0.19)	7.1 (0.28)	3.2 (0.13)	0.7 (0.03)	2.5 (0.10)	—	ISO standard pipe
6.35 (0.25)	8.77 (0.35)	—	0.83 (0.03)	—	1.02 (0.04)	SAE standard pipe
12 (0.47)	15.3~16.3 (0.60~0.64)	9.5~10.5 (0.37~0.41)	0.9 (0.04)	1.8 (0.07)	1.6 (0.06)	JASO standard pipe
15 (0.59)	18.0~19.0 (0.71~0.75)	12.5~13.5 (0.49~0.53)	1.0 (0.04)	2.0 (0.08)	1.6 (0.06)	

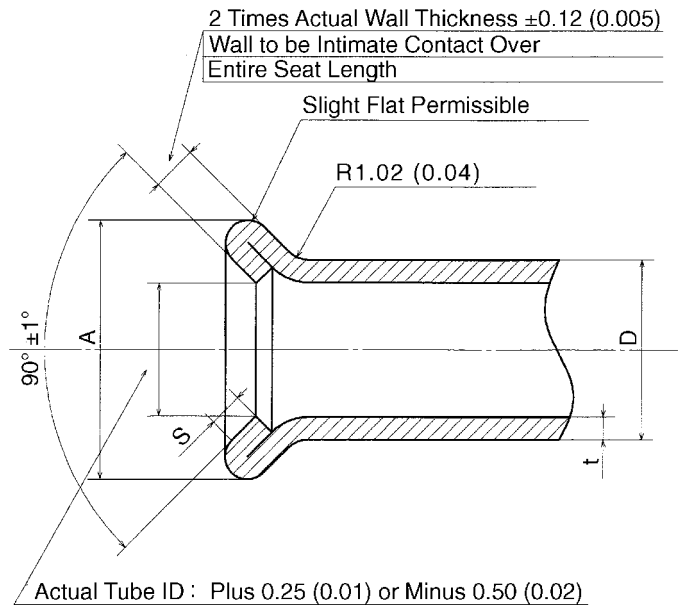
ISO STANDARD PIPE

Flare shape is as follows, ISO 4038.



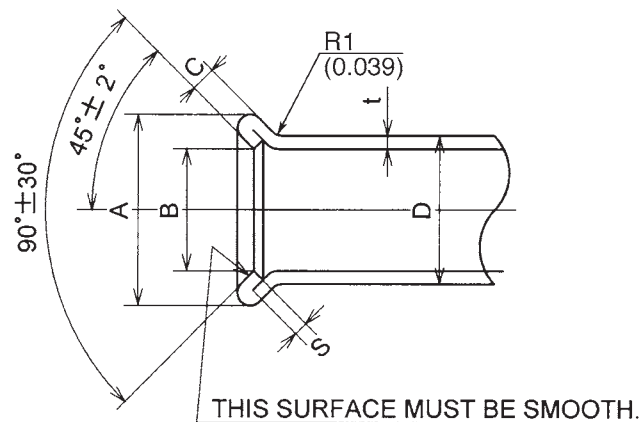
SAE STANDARD PIPE

Flare shape is as follows, SAE J53.



JASO STANDARD PIPE

Flare shape is as follows.



[DETAILS OF MATERIAL]

Unit : mm (in.)

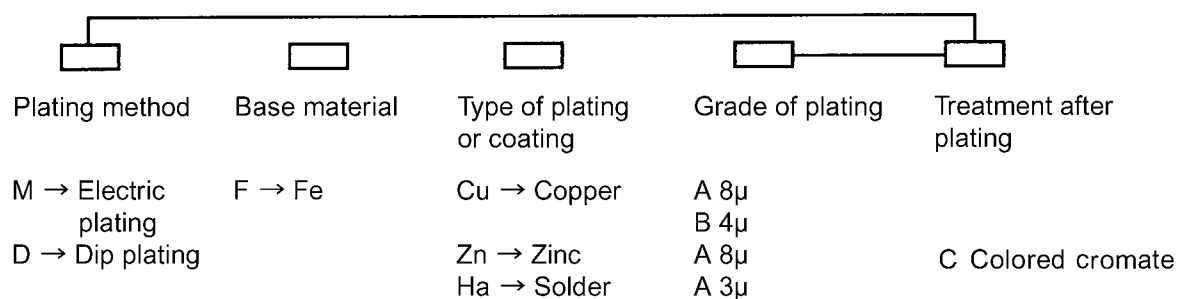
Pipe dia.	Type	1) Pipe	2) Plating Code	
			Inside	Outside
4.76~10 (0.19~0.39)	Double-wound plated steel pipe	HSTD2	MFCuB	MFZnA-C++Plastic
10 (0.39)		HSTD3	MFCuA	MFZnA-C++Plastic
6.35~15 (0.25~0.59)	Plated carbon steel pipe for mechanical structures	HSTKM3	MFCuB	MFZnA-C++Plastic
10~15 (0.39~0.59)		HSTKM1	MFCuA	MFZnA-C++Plastic

[Notes]

- Chemical composition and mechanical properties

Pipe	Chemical composition %						Mechanical properties					
							Tensile strength			Bedding test		
	C	Mn	P	S	Si	Cu	Tensile strength kg/mm ²	Yield point kg/mm ²	Elonga- tion (%)	Applicable pipe dia. mm	Bending angle	Inside dia. (D=pipe dia.)
HSTD2	≤ 0.12	≤ 0.50	≤ 0.04	≤ 0.045	—	—	≥ 30	—	≥ 25	≤ 8	360°	1.5D
HSTD3	↑	↑	↑	↑	—	—	↑	—	↑	≤ 10	↑	3D
HSTKM1	≤ 0.25	0.30 ~0.90	≤ 0.04	≤ 0.04	≤ 0.35	—	≥ 38	≥ 22	≥ 25	≥ 12	90°	6D
HSTKM3	↑	↑	↑	↑	↑	—	↑	↑	↑	≤ 10	↑	↑

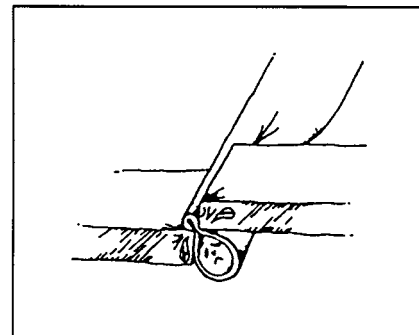
- Plating code



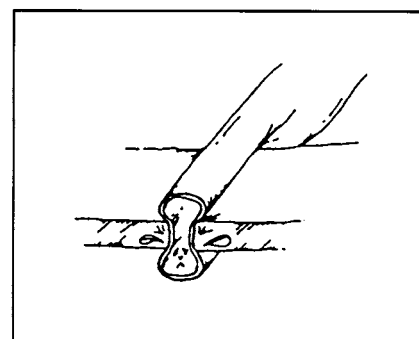
Precautions when Mounting a Body or Equipment

Avoiding Interference with Piping

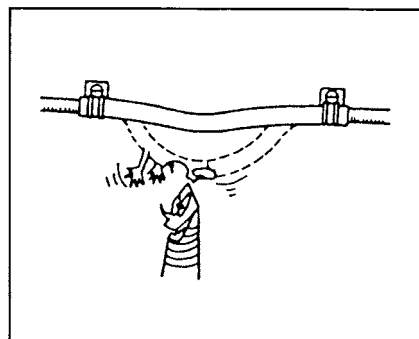
Take care that the piping is not caught by other parts.



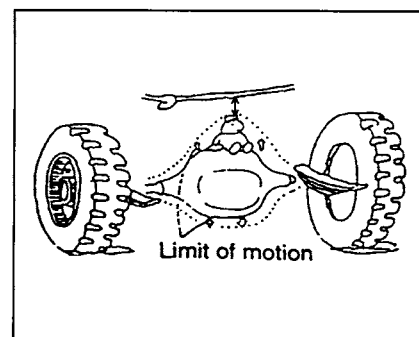
Be sure that the piping is not flattened.



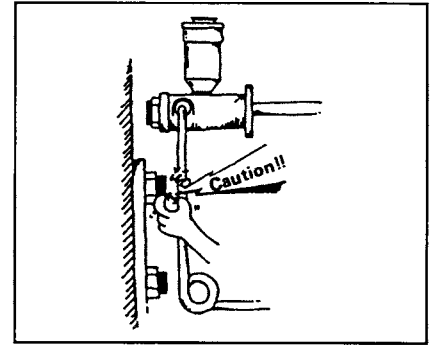
See to it that the piping is not in contact with the sharp-angle portion of other parts.



Pay attention to the displacement of the brake hose connected to the front and rear wheels while the vehicle is running.



Secure a sufficient clearance between the brake piping and installed parts.



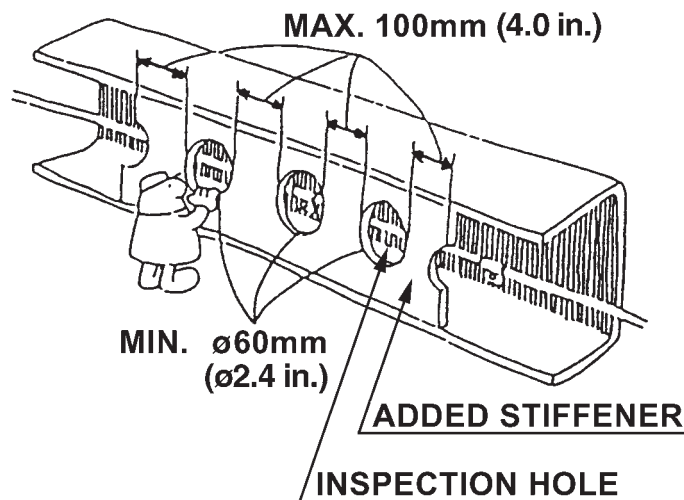
The joints of pipes and hoses must be accessible to allow tightening and so that pipes and hoses can be removed.

If you have fitted stiffeners to bridge the gap between the flanges of side rail, be sure to cut inspection holes in the stiffener.

The pitch between holes must be 100 mm (4.0 in.) or less, and the diameter of the holes must be at least 60 mm (2.4 in.).

Make sure that the holes are in front of the clips used to secure the piping to the side rail.

You must be able to insert or remove the clips using a box wrench.



Make sure that brake component parts are easily accessible.

- Drains are fitted under the air tank and relay valve. When mounting a body or equipment, make sure that the drains are easily accessible.
- Make sure that the following parts are easily accessible for maintenance and replacement:

Air dryer	Pressure regulator	Double check valve
Relay valve	Safety valve	Spring brake control valve
	ABS valve	ABS modulator

Allow sufficient clearance between the brake pipes, hoses, nylon tubes and mounted body or equipment.

When mounting the body or equipment, make sure that body and equipment do not interfere with the brake system.

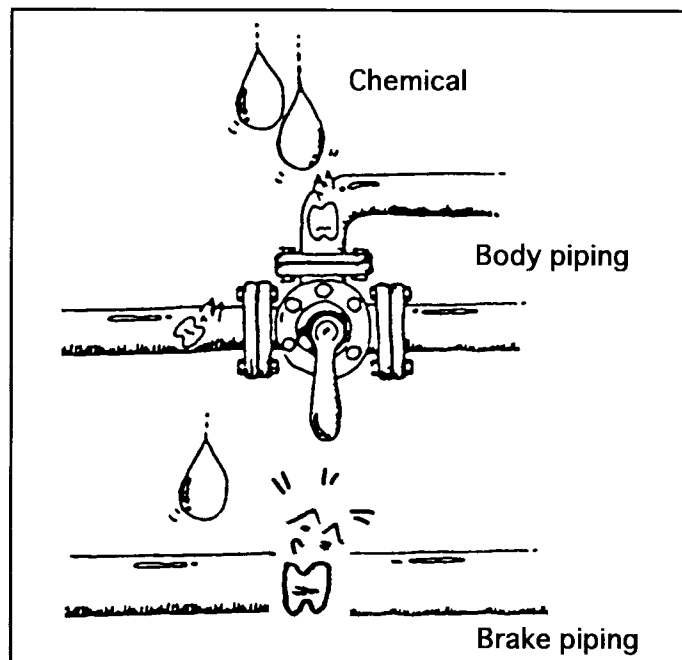
- Clearance with engine
- Clearance with brake component parts
(Pipes, hoses, nylon tubes, devices of ABS, etc.)
- Clearance with hoses around axles
(Must be consider the maximum movement of axles)
- Clearances with rubber parts
(For more details of required clearances, see "PIPING CLEARANCE" here in after.)

Condensation and corrosion prevention of piping

Corrosion of brake piping for body applications such as, but not limited to liquid oxygen truck, vacuum tank truck, or tanker truck is promoted by condensation.

(Such as the liquid oxygen inlet/outlet.)

Keep the brake piping away from or cover it with a protective plate at portions where dew forms or water drops easily.



Precautions for Modification (Alteration)

Avoid piping modification(s) if possible.

If you modify piping, be sure to observe the following precautions.

PIPING

- When extending a pipe, do not join two pipes directly.
- When joining pipes, use the flare joint method and avoid twisting the pipes too much.

[NOTE]

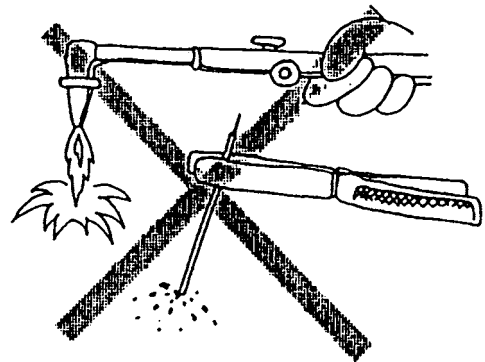
Tightening torque of flare nut.

Unit: kgf·cm (lb·ft)

Pipe external diameter mm (in.)	ø4.76 (ø0.19)	ø6.35 (ø0.25)	ø12 (ø0.97)	ø15 (ø0.59)
Pipe material				
Steel	150±50 (11±4)	250±50 (18±4)	680±70 (49±5)	900±80 (65±6)

Most pipes are made of steel but have anti-corrosive plating on the inside and the outside. Never braze these pipes and never heat them to high temperatures.

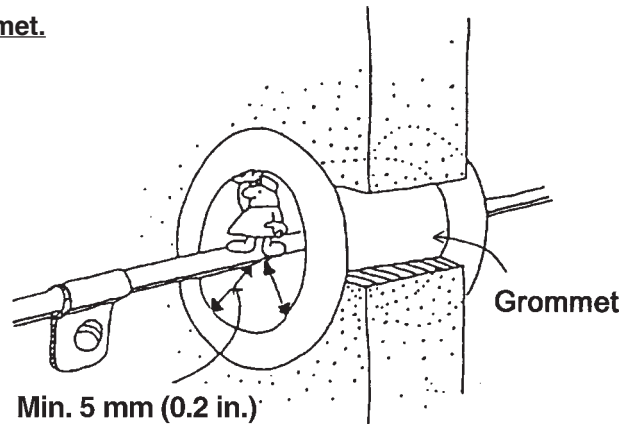
Do not weld or braze brake piping and do not heat to high temperatures.



Do not use copper pipes for piping in areas below unsprung parts as on axles.

Where pipes pass through the chassis frame, use a grommet in the hole and secure the pipe with clips close to the hole so that the pipe does not touch the hole or the grommet.

Use of Grommet.



When remove the transmission, it is necessary to pull the transmission assembly backwards in the line of the crankshaft.

Therefore, do not install piping in areas around the transmission (The area is between transmission and No.3 crossmember).

Where piping may be affected by the failure of other equipment, install the pipes inside the side rail or crossmembers, and do not allow them to protrude below the bottom flange surface of the chassis frame.

Do not install piping between the spring brackets of the front and rear suspensions (outside the lower flange surface of the side rail) or within the range of movement of the spring.

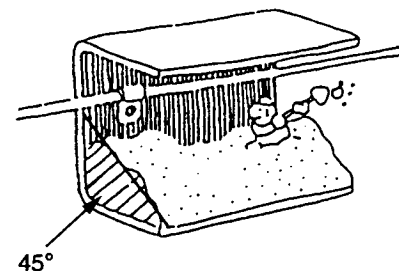
The piping located on the axle below the springs is carefully designed to prevent damage from the complex vibrations which arise in this area. Do not modify this piping.

Do not install piping near to the moving parts such as propeller shaft and P.T.O. drive shaft.

Do not install piping in places where earth, sand, or water accumulate.

Avoid covering pipes with rubber or vinyl tubes as this tends to trap water.

Install pipes high enough so that they are not covered by any earth or sand that may accumulate on the lower flange.



To protect the piping locate inside of side rail or behind crossmember.
(Piping minimum clearance required = 5mm (0.2in.) from side rail and crossmember.)

Don't locate the piping behind the end of the exhaust tail pipe.

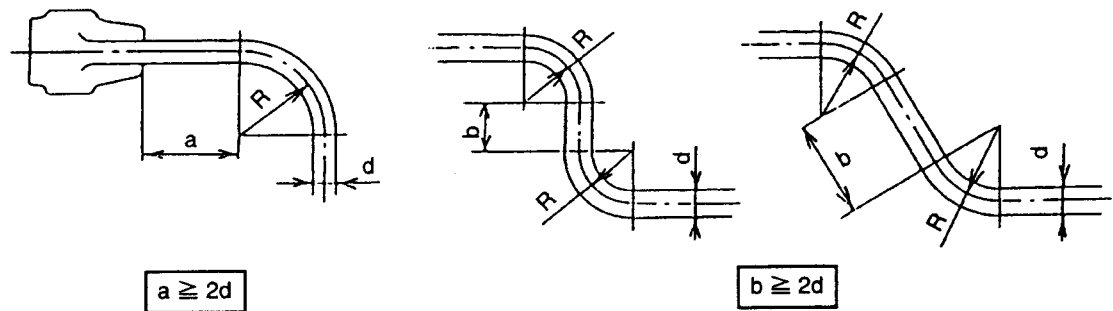
When bending pipes, observe the following precautions.

- Use a bender and do not heat the pipes in order to bend them.
- Observe the standard bending radiuses shown in the table below

Unit: mm (in.)

Nominal dia. of pipe	4.76 (0.19)	6.35 (0.25)	12 (0.47)	15 (0.59)
Standard bending R	20 (0.79)	20 (0.79)	30 (1.18)	40 (1.57)

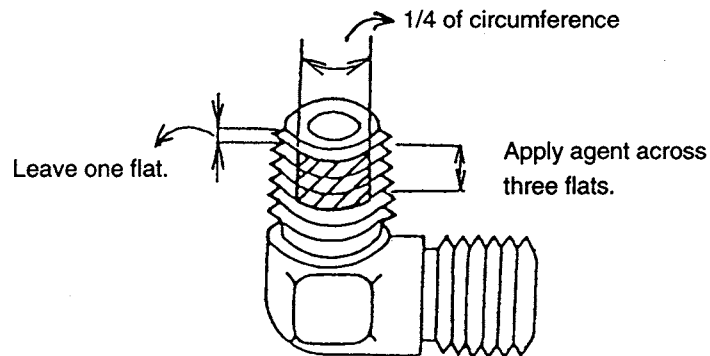
- The minimum lengths of the straight section at the end of a pipe and of the straight section between two bends are shown in the drawing below.



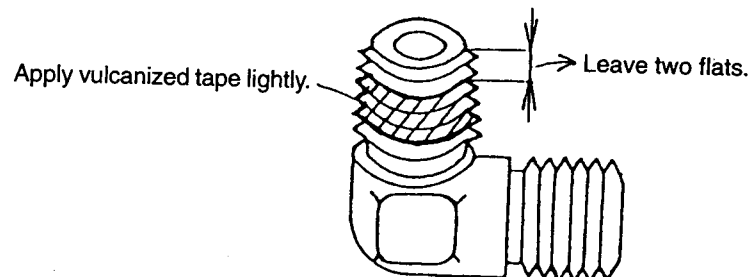
- Flush the inside of the pipe and remove any foreign matter before use. Use compressed air to flush the pipe.
- For details of pipe machining at the flare nut, see described in forward paragraph "Brake Piping Used in the Chassis".
After machining, remove any foreign matter by flushing the pipe with compressed air.

Using sealing agents on tapers

- If possible, use a strong anaerobic sealing agent (Genuine Hino product or locktight #575).
- Clean tapers with cotton waste and thinners before coating with sealing agent. If you intend to reuse joints which have been sealed with anaerobic sealing agent or vulcanized tape, make sure you remove all trace of the old sealing agent or tape before re-sealing.
- Always apply sealing agent starting at one flat from the tip of the male thread, and apply the agent across three flats over one quarter of the circumference of the thread. Apply approximately 0.1 g (0.04 oz.) of agent to each joint.



- When using vulcanized tape, make sure that the sealing agent does not penetrate any valve, etc. (If the sealing agent penetrates a valve, it may block the valve.) As a standard, leave two flats from the tip of the thread and apply 1.5 ~ 2 turns of vulcanized tape.



Inspection after fitting

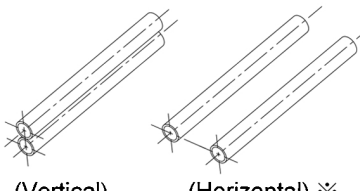
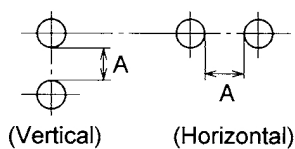
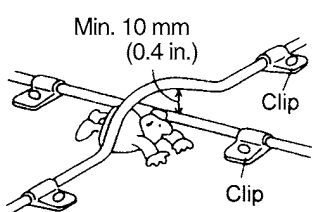
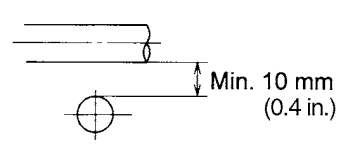
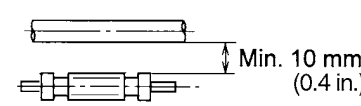
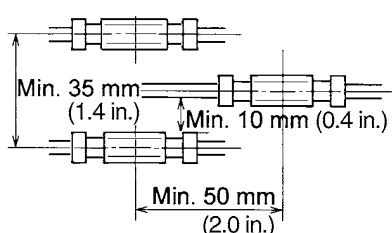
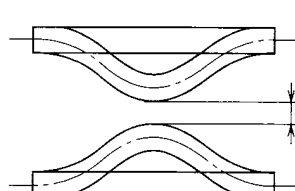
After tightening the joint,

- Make sure that there are no air or oil leaks.
- Make sure that the fitting does not place any strain on the pipe or hose (bending, distortion, etc.).

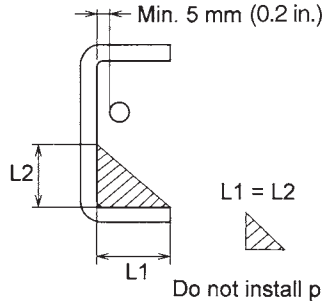

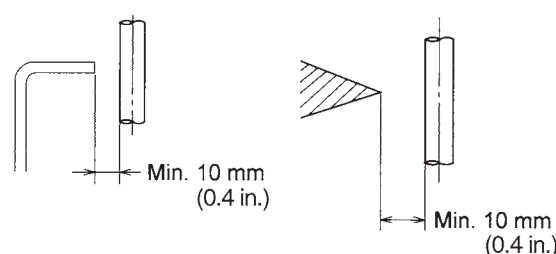
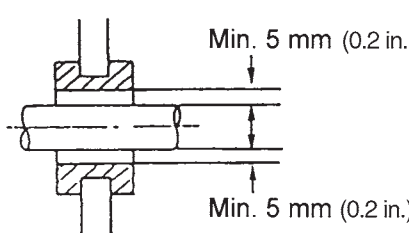
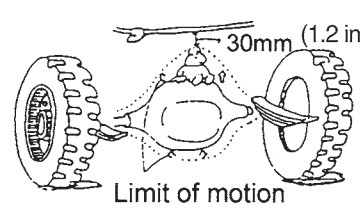
Piping Clearances

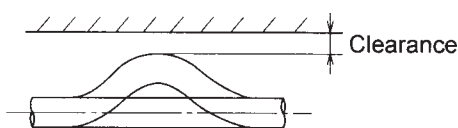
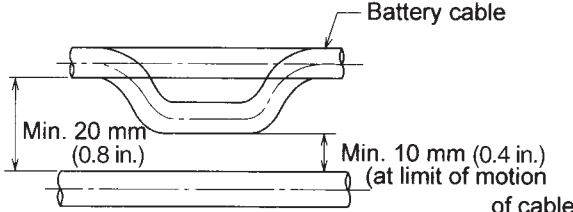
To prevent rust and damage from contact with other parts. When modifying piping, observe the following precautions.

Clearances Between Two Pipes

No.	Position	Clearances
1	Between two pipes. • Parallel piping.  (Vertical) (Horizontal) ※	 (Vertical) (Horizontal) A Min. 10 mm (Horizontal) ※ (0.4 in.) 0 (Vertical) <p>※ : Prevents the accumulation of mud, etc</p>
2	Pipe crossing points.  Min. 10 mm (0.4 in.) Clip Clip	 Min. 10 mm (0.4 in.) Use clips to secure pipes near crossing points.
3	Between a pipe and a joint.	 Min. 10 mm (0.4 in.)
4	Between two joints.	 Min. 35 mm (1.4 in.) Min. 10 mm (0.4 in.) Min. 50 mm (2.0 in.)
5	Between two hoses.	 At maximum displacement min. 20 mm (0.8 in.)

Clearances Between Pipes and Other Parts

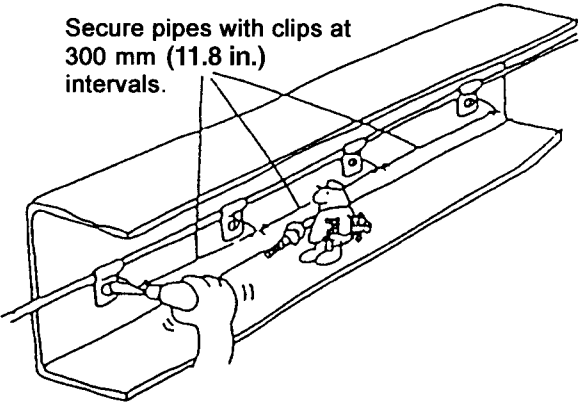
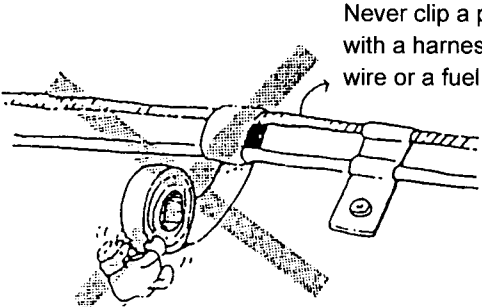
No.	Position	Clearances
1	Between pipes and side rail.	 <p>Min. 5 mm (0.2 in.)</p> <p>Do not install pipes in shaded area.</p>
2	Between a pipe and a flat metal surface.	 <p>Min. 5 mm (0.2 in.)</p>
3	Between a pipe and a metal corner or edge.	 <p>Min. 10 mm (0.4 in.)</p> <p>Min. 10 mm (0.4 in.)</p>
4	Between a grommet and a pipe.	 <p>Min. 5 mm (0.2 in.)</p> <p>Min. 5 mm (0.2 in.)</p>
5	Between pipes and metal structural parts. • Between a pipe and a moving part.	<p>Min. 10 mm (0.4 in.)</p> <p>• But min. 30 mm (1.2 in.) clearance from limit of motion of moving part.</p>  <p>30mm (1.2 in.)</p> <p>Limit of motion</p>

No.	Position	Clearances
6	Between a hose and a structural part.	<p>Make sure that clearances of brake and air hoses linked to wheels are at least 50 mm (2.0 in.) during driving.</p> <p>Take account of vibrations(e. g. when steering is at full lock). Clearances for other hoses at the limit of motion must be:</p> <ul style="list-style-type: none"> • at least 10 mm (0.4 in.) from flat surfaces • at least 30 mm (1.2 in.) from corners and edges 
7	<p>Between hoses or pipes and heated parts (exhaust system, etc.).</p> <ul style="list-style-type: none"> • Air pipe • Brake hoses 	<p>Min. 100 mm (3.9 in.)</p> <p>Min. 200 mm (7.9 in.) at limit of motion. If this is not possible, protect the hose with heat absorbing plates.</p>
8	<p>Between hoses or pipes and electrical parts.</p> <ul style="list-style-type: none"> • Between a pipe and a battery cable. • Between pipes and electric terminals. • Between pipes and harness wires. 	 <p>Min. 20 mm (0.8 in.)</p> <p>Min. 10 mm (0.4 in.) (at limit of motion of cable)</p> <p>Min. 30 mm (1.2 in.)</p> <p>Between parallel pipes/wires at limit of sag : Min. 10 mm (0.4 in.) At crossing points Min. 20 mm (0.8 in.)</p>

Piping Retention

Pipes must be secured with clips to prevent them from swinging due to the motion of the vehicle.

Use vinyl-coated or rubber-coated clips and follow the rules given in the table below.

No.	Item	Notes
1	<p>Clip spacing</p>  <p>Secure pipes with clips at 300 mm (11.8 in.) intervals.</p>	<p>However, at bends, crossing points, joints, and where pipes and wires, etc. are installed in parallel, and are subject to movement, and where two copper pipes are installed, reduce the spacing of clips to prevent any vibration.</p>
2	<p>Clipping two items with one clip. Never bind two pipes together with tape.</p>  <p>Never clip a pipe with a harness wire or a fuel pipe.</p>	<p>Never clip a pipe and a harness wire together with one clip. Fuel pipes may only be clipped together with copper pipes. Never clip fuel pipes together with vinyl hoses or rubber hoses.</p>
3	<p>Maximum number of pipes clipped together.</p>	<p>A maximum three pipes.</p>

Precautions to Take when Handling Nylon Tubes for Brakes

Nylon tubes are used in the air braking system. Caution should be exercised against heating when welding.

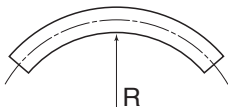
If welding is required, nylon tubes need to be protected against welding spatter, etc..

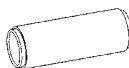

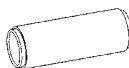

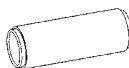

For other general precautions, refer to the instructions shown on the following table.

When dismounting and remounting the piping for the reason of facilitating the maintenance, inspection of the brake and air line as well as of body or equipment mounting, make sure to put matching marks (using paint, tape, tag, etc.) on the equipment side as well as on the piping side to prevent incorrect connections.

Incorrect connections and/or mounting of equipment and piping can cause a serious functional damage to the system using brake line and air line.

Precautions to take for handling nylon tubes when mounting the body

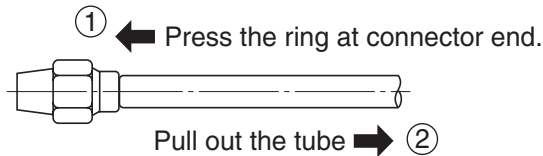
	Point to pay attention for handling	Contents		Influence on the performance								
1	Protection of nylon tube when welding or grinding with a sander.	Fit a protecting cover on the nylon tube or remove it according to the necessity.		If welding sparks, etc are projected on the nylon tube, the tube may melt and cause air leakage sometimes.								
2	Protection of nylon tube when a body or equipment interfere with nylon tube.	Securely fix a body or equipment with a clamp to the nylon tube protected with corrugated tube existing around it.		If nylon tube keeps on interfering with a body or equipment, the tube may break and cause air leaking sometimes								
3	Prevention of introduction of foreign matters into the nylon tubes and connectors.	When dismounting and remounting the nylon tubes and the connectors, cover them with vinyl sac, etc (sac producing fiber dust is not suitable) to prevent sticking and / or introduction of foreign matters.		Biting of foreign matters by valves and connectors may sometimes cause air leakage or malfunctioning of valves.								
4	Protection against interference of nylon tubes.	Matching parts	Gap	Holes may sometimes appear on the tubes and pipes due to rubbing and wear and may result in air leakage.								
		Chassis parts (fixing position)	5mm (0.2 in.)									
		Engine,transmission, cab, etc (relative moving position)	30mm (1.2 in.)									
		Tires, propeller shaft, etc (rotating position)	50mm (2.0 in.)									
		Components for upper structures	Equivalent to the above									
5	Securing gaps with exhaust system.	Secure gaps of more than 200mm (7.9 in.) between the nylon tubes and the exhaust system (exhaust pipe, muffler, etc) or protect the tubes by covering them with insulators, etc. Also, be sure to fit insulators on the flange section of the exhaust system.		High temperature due to the heat of the exhaust system may cause sometimes melting of the tubes and may result in air leakage.								
6	Prevention of swinging of the nylon tubes.	Provide appropriate clip bands to the nylon tubes to avoid swinging of the tubes after mounting. : <ul style="list-style-type: none">• Gaps of the clip bands should have pitches less than 400mm (15.7 in.).• Clip band to use : S4783-71230		If the clip gap is too big, tubes may swing to rub against other parts and may cause contact wear, this leading sometime to occurrence of air leakage.								
7	Securing of bending "R" for nylon tubes.	<p>The minimum bending "R" for the nylon tubes should be as indicated on the following table. Avoid bending the tubes with the bending "R" smaller than the one indicated in the table.</p> <div></div> <table><tr><td>Outside diameter of nylon tube</td><td>R mm (in.)</td></tr><tr><td>1/4"</td><td>41 (1.6)</td></tr><tr><td>3/8"</td><td>74 (2.9)</td></tr><tr><td>1/2"</td><td>88 (3.5)</td></tr></table>		Outside diameter of nylon tube	R mm (in.)	1/4"	41 (1.6)	3/8"	74 (2.9)	1/2"	88 (3.5)	If a tube is bent with the bending "R" less than the minimum bending "R" ,the air may be clogged by broken tube and air leakage may occur by the end position of the connector.
Outside diameter of nylon tube	R mm (in.)											
1/4"	41 (1.6)											
3/8"	74 (2.9)											
1/2"	88 (3.5)											

	Point to pay attention for handling	Contents	Influence on the performance																																						
8	Prevention of adherence of acidic liquid.	As nylon tubes are weak against acid, be careful so that they might not be caught by battery liquid. Don't use waste cloth or cotton work gloves contaminated with battery liquid.	Sticking of acidic liquid such as battery liquid melts the tube and risks to cause air leakage.																																						
9	Prevention of water penetration at the time of high pressure washing.	Secure the distance minimum of 300mm (11.8 in.)(and above between the connector and the injection port when performing high pressure washing.	If the distance between the connector and the injection port is not sufficient, water may penetrate into the piping, thus causing rusting, freezing, and malfunctioning of valves.																																						
10	Protection of nylon tubes when performing forced drying of paint.	As the temperature service limit of the nylon tube is from-40 to 100°C (104 to 212°F), remove the nylon tube when using a drying booth whose service temperature exceeds this limit.	If this service limit is exceeded, air tightness of the tube will be reduced and may cause air leakage sometimes.																																						
11	Spare parts.	<p>Never fail to use genuine Hino spare parts. Otherwise, the nylon tube may be damaged.</p> <ul style="list-style-type: none">Connectors for intermediate connection of nylon tubes <table><tr><th>Outside diameter of tube</th><th>Part No.</th><td rowspan="4"></td></tr><tr><td>1/4"</td><td>S3480-14750</td></tr><tr><td>3/8"</td><td>S3480-14760</td></tr><tr><td>1/2"</td><td>S3480-14770</td></tr></table> <ul style="list-style-type: none">Sleeve connectors <table><tr><th></th><th>1/4"</th><th>1/2"</th><td rowspan="4"></td></tr><tr><td>Nut</td><td>SZ179-11003</td><td>SZ179-17001</td></tr><tr><td>Sleeve</td><td>S4938-41040</td><td>S4938-41030</td></tr><tr><td>Insert</td><td>S4485-41130</td><td>S4485-41110</td></tr></table> <ul style="list-style-type: none">Nylon tubes <table><tr><th>Outside diameter of tube</th><th>Part No. L = 6m (20 ft.)</th></tr><tr><td>1/4"</td><td>SM415-07600</td></tr><tr><td>3/8"</td><td>SM415-09600</td></tr><tr><td>1/2"</td><td>SM415-13600</td></tr></table> <ul style="list-style-type: none">Corrugates tubes <table><tr><th>Outside diameter of tube</th><th>Part No. L = 1.2m (4 ft.)</th></tr><tr><td>1/4"</td><td>SR291-07120</td></tr><tr><td>3/8"</td><td>SR291-10120</td></tr><tr><td>1/2"</td><td>SR291-13120</td></tr></table> <ul style="list-style-type: none">For one-touch type connectors, kindly contact authorized Hino distributor nearest to you.	Outside diameter of tube	Part No.		1/4"	S3480-14750	3/8"	S3480-14760	1/2"	S3480-14770		1/4"	1/2"		Nut	SZ179-11003	SZ179-17001	Sleeve	S4938-41040	S4938-41030	Insert	S4485-41130	S4485-41110	Outside diameter of tube	Part No. L = 6m (20 ft.)	1/4"	SM415-07600	3/8"	SM415-09600	1/2"	SM415-13600	Outside diameter of tube	Part No. L = 1.2m (4 ft.)	1/4"	SR291-07120	3/8"	SR291-10120	1/2"	SR291-13120	
Outside diameter of tube	Part No.																																								
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Dismounting and remounting procedures for one touch type connectors

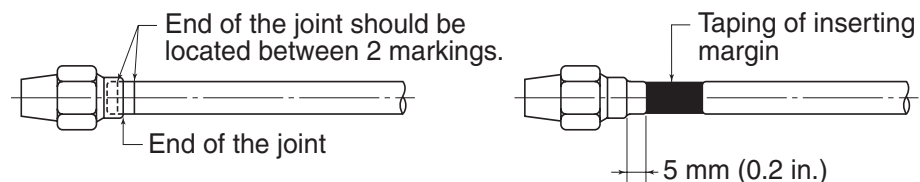
Procedure for dismounting

- Before performed dismounting, drain the air from all air tank.
- Confirm that there is no dust nor dirt around the ends of the connector. If any dust or dirt is found sticking there, eliminate it completely by air blowing, etc.
- Keeping the end portion of the connector pressed, pull out the nylon tube by hand without break in the middle along the axial direction of the connector.



Procedure for remounting

- Confirm that there is no flaw, crush, dirt, burr nor dust, etc around the inserting position of the nylon tube. If a flaw or a crush is found out, follow the instruction for repair described here in after.
- Match the axis of the nylon tube with that of connector and insert the tube all the way without break until it stops. At this moment, be careful not to touch the inserting portion with fiber cloth such as cotton work globes, etc.
- After mounting, pull the nylon tube by hand to check if the nylon tube has been securely connected.
- After pulling, check if the end of the joint terminal is located between the 2 markings of the nylon inserting margin and that the gap between the end of the connector and of the end of the nylon tube inserting margin is less than 5mm (0.2 in.) when the nylon tube has been repaired.



- With the condition that the air is filled in the piping, check if there is any leakage of air by applying soapy water to the connecting position.
If any air leakage is found out, follow the instruction for modification described here in after.

Dismounting and remounting procedures for nylon tubes for sleeve type connectors

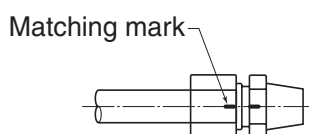
The sleeve type connector consists of a connector, nut, sleeve and an insert and the nut, sleeve and the insert are supplied as assembled by the manufacturer.

The nut, sleeve and insert are not reusable once they are disassembled.

If repair is required, carry out the work according to the following procedure.

Procedure for dismounting

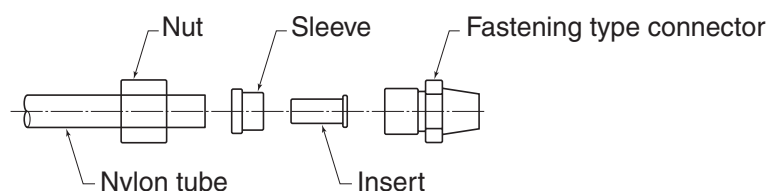
- Before loosening the nut, put the matching mark between the connector and the nut so that the position can be visible. (marking by a magic ink is acceptable.)






- Loosen the nut and pull out the tube by hand in the axial direction while paying attention so that the sleeve and the insert may not fall off.

Procedure for remounting

- Put the nut and the sleeve onto the tube and put the insert into the tip of the tube. (Pay attention to the remounting direction.)



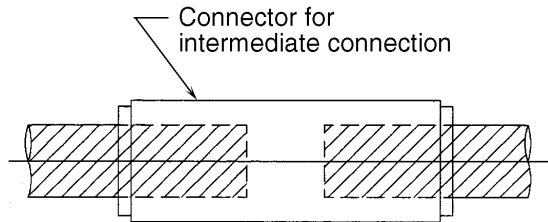
- Drive the insert until the tip of the insert hits the connector while paying attention so that the nut, sleeve and the insert may not fall off and, under this condition, fully tighten the nut by hand.
- Hold the tube so that it may not move (comes off), tighten the nut up to the position before dismounting (matching mark) and retighten it by 60°. Further tighten the nut using the tool until the prescribed torque is obtained.
- Check the air leakage with a soapy water, etc. If any air leakage has been found out, retighten the nut until the air leakage stops.
- If the leakage does not stop, replace the tube, sleeve and the insert. If in spite of such replacement, the leakage does not stop, replace the nut and the connector in addition.

	1/4"	1/2"	
Nut	SZ179-11003	SZ179-17001	
Sleeve	S4938-41040	S4938-41030	
Insert	S4485-41130	S4485-41110	

Procedure for repairing the nylon tube

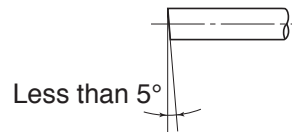
When repair becomes necessary due to appearance of harmful defects such as breakage, crush, perforation, etc., carry out the repair according to the following instruction. (applicable only to the position which is not apparent such as the inside of the frame, etc.)

- Prepare a nylon tube having the same size as that of the nylon tube to repair and a connector for intermediate connection (exclusively for repair).

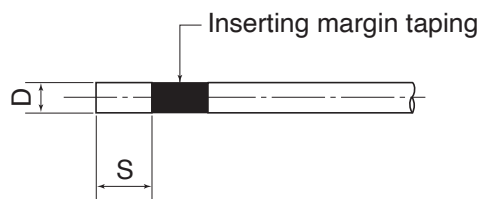


Outside diameter of tube	Part No.	
1/4"	S3480-14750	
3/8"	S3480-14760	
1/2"	S3480-14770	

- Confirm the position of the defect on the nylon tube and decide the cutting position to such place where the connector is mountable. Use a cutter for cutting.
- Check if the cutting face of the nylon tube is smooth without any burr and that the cutting face is $90^\circ \pm 5^\circ$ to the axis of the nylon tube.

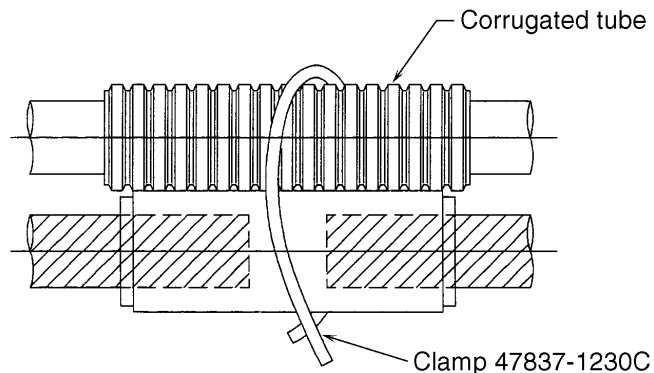


- Wind the inserting margin taping according to the following table. (In the same way as in the case of one-touch type connector)



D (Outside diameter of tube)	S (Inserting margin) mm (in.)
1/4"	18±1 (0.71±0.04)
3/8"	22.5±1 (0.89±0.04)
1/2"	25.5±1 (1.00±0.04)
5/8"	28.5±1 (1.12±0.04)

- Remount the connector according to the dismounting and remounting procedures of the nylon tube.
- Securely fix the repair connector with a clamp to the nylon tube protected with corrugated tube existing around it. If this does not exist around it, add the corrugated tube.
- In the event that such repair work is difficult to carry out for the reason of layout or for the reason of influencing on the external appearance such as on the air tank or that the tube is relatively short and its replacement can be done easily, replace the nylon tube with a new one.



In the event that an air leakage has occurred after remounting of the nylon tube, take the following measure (applicable only when the nylon tube has enough surplus length).

- Remove the parts of the nylon tube that suffers from the air leakage together with the connector according to the dismantling procedure.
After dismantling, keep the outside and the inside of the connector free from any adhesion of dust or dirt.
- Cut the nylon tube over the range of 15 to 20 mm (0.6 to 0.8 in.) from its end. Also, if any flaw is found out within this range, cut the tube at the position where the flaw is no more recognized. In the event that it is impossible to define the cutting position, replace the nylon tube with a new one.
- Eliminate those matters sticking to the inside of the dismantled connector by air-blowing. If any damage or heavy sticking of foreign matters is found out, replace the connector with a new one.
- Wind an insert margin tape around the nylon tube (in the case of one-touch connector), Mount the tube according to the remounting procedure. In the case of a nylon tube of single parts or the case of the tube whose overall length is less than 500 mm (20 in.), piping becomes difficult. In such a case, replace it with a new parts.

Tightening torques

Tightening torque for tapered joint

Unit: kgf·cm (lb·ft)

Thread dia. (in.) Material	1/8	1/4	3/8	1/2
Steel	200±50 (15±4)	500±100 (36±7)	650±150 (47±11)	
Aluminum copper	200±50 (15±4)	250±50 (18±4)	350±50 (25±4)	450±50 (32±4)

Tightening torque for sleeve type connector

	ø1/4	ø3/8	ø1/2
kgf·cm (lb·ft)	156±30 (11.3±2)	234.5±51 (17±4)	285.5±51 (20.7±4)

Tightening torque for flare nut of female flare joint and male flare joint

Dia. mm (in.)	ø4.76 (ø0.19)	ø6.35 (ø0.25)	ø10 (ø0.39)	ø12 (ø0.47)	ø15 (ø0.59)
Torque for steel pipe kgf·cm (lb·ft)	150±50 (11±4)	250±50 (18±4)	530±70 (38±5)	680±70 (49±5)	900±80 (65±6)

Tightening torque for bolt and nut

	M6	M8	M10	M12	M16	M20	M22
4T kgf·cm (lb·ft)	55±11 (4±1)	175±30 (13±2)		490±100 (35±7)	980±195 (70±14)	1230±370 (90±27)	1350±300 (98±22)
7T kgf·cm (lb·ft)	90±18 (7±1)	225±40 (16±3)		930±185 (67±13)			

The conventional units in the parenthesis () in the table as well as the figures connected therewith are shown as reference.

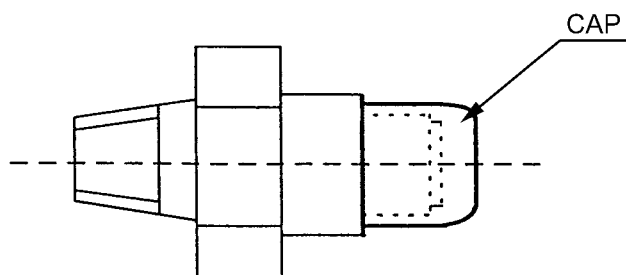
[NOTE] Hino reserves the right to modify the parts connected with nylon tubes for brakes without notice.

When placing your order for spare parts, kindly consult HMC or Hino authorized dealer.

Precautions for handling one-touch type connector

	Precaution to take when handling	Contents	Description
1	Assurance of quality for parts in stock.	<ul style="list-style-type: none"> Do not use the joint without cap or with cap detached but burn it down. In such case, securely crash the one-touch type connector with a hammer. 	<ul style="list-style-type: none"> The cap is fitted in order to avoid deformation, flaw, introduction of dust and dirt. If the one-touch type connector is used without cap, this may sometimes cause air leakage or detaching of the tube.
2	Assurance of quality during the transport.	<ul style="list-style-type: none"> Do not attempt a rough handling which will cause detaching or deformation of the cap. 	<ul style="list-style-type: none"> If the one-touch type connector receives a strong external force through the cap by falling it down or due to a rough handling, air leakage or detaching of tube may occur sometimes.
3	Assurance of quality when assembling a new one-touch type connector on the vehicle.	<ul style="list-style-type: none"> Be sure to mount the one-touch type connector with cap fitted. Carry out removal of the cap at the time of insertion of the nylon tube. 	<ul style="list-style-type: none"> Presence of deformation or flaw may cause sometimes air leakage or detaching of the tube.

[Protection cap of one-touch type connector]



10. ELECTRIC WIRING MODIFICATIONS

This section is not applicable.

11. ALTERATION OF EXHAUST SYSTEM

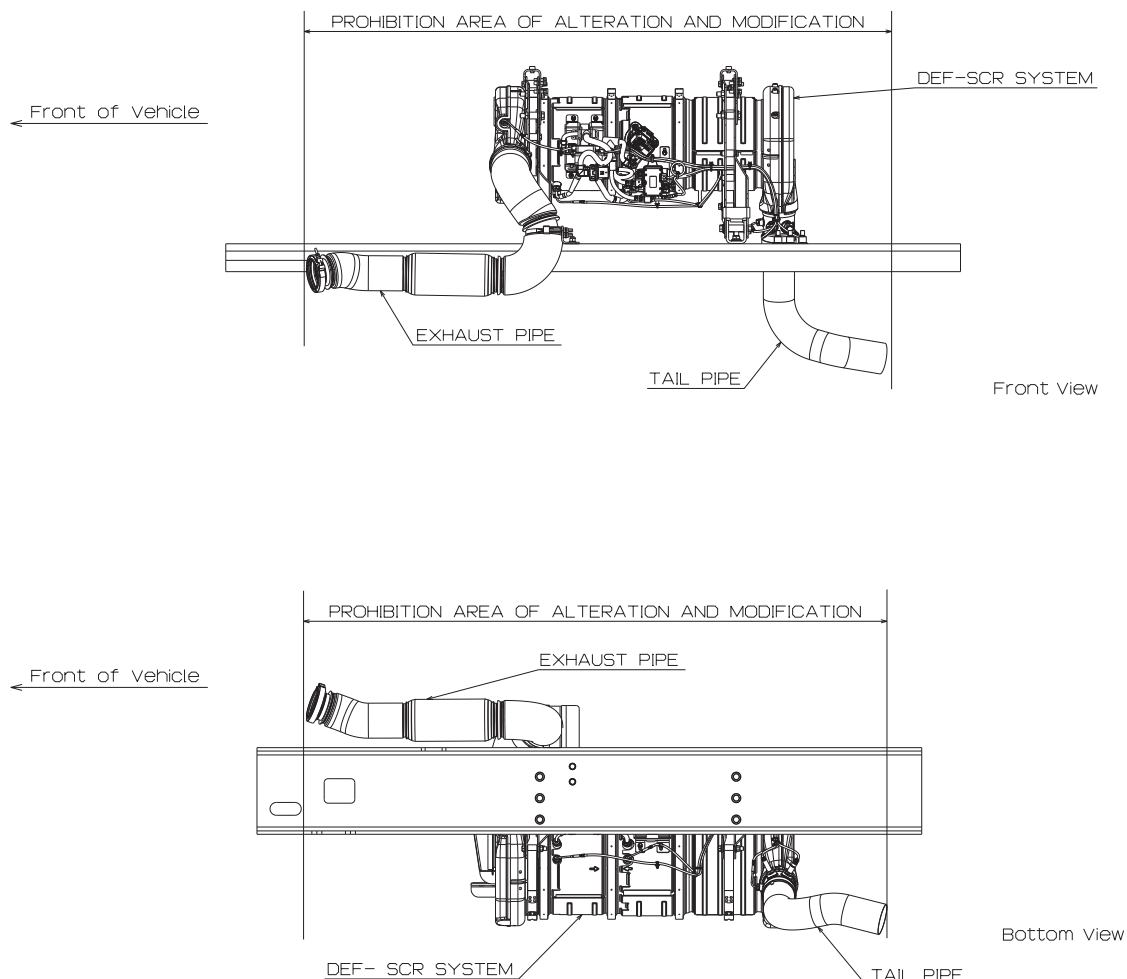
- The body builder “Must” not modify or relocate any devices included in the emissions system. It is also the case that there should not be any modifications made to the exhaust piping from turbo outlet to aftertreatment inlet. Doing so may result in the voiding of all warranties and the occurrence of an emissions noncompliance event that may be considered tampering and punishable by the assessment of penalties by the EPA and ARB as well as the need for remedial measures.
- Modification of the emissions system can only be done with the preapproval of Cummins and chassis OEM. Body builders’ first point of contact concerning emissions systems modifications “Must” be the chassis OEM. The chassis OEM will notify Cummins of the potential modification of any engine component. If an emissions systems modification is preapproved, the chassis OEM “Must” supply the necessary information and kits (if available from the OEM) to properly perform the modification.

Since the exhaust system is a thermal parts, when other parts of vehicle are mounted above it, follow the instructions given Chapter 4, for preventing fire hazard.

Any alteration to the exhaust system is undesirable, for it will affect the engine performance, exhaust fume density, fire hazard prevention.

Prohibition Area of Alteration and Modification

< Day Cab >



12. CAUTIONS NEEDED IN ADDITIONAL MACHINING AND ALTERATION OF THE CAB

When the cab floor has been drilled or notched in order to install some device, appropriately steel stiffener around the hole or notch, since the floor is reduced in strength by making holes or notches. Where the lever and the like passes through the floor, use a rubber boot and the like to seal off the gap to shut off a draft and noise.

In case of cab alteration, pay attention to rust prevention.

Considerations are needed not to hamper the accessibility to the heater cover and other parts for service.

13. AXLE MODIFICATIONS

Addition of tag/pusher axles is prohibited.
Chassis has not been evaluated with additional axles.

Hino Engineering does not support modification of the axles or axle brackets.
Modification by customer can affect long term performance and durability of the axles.