

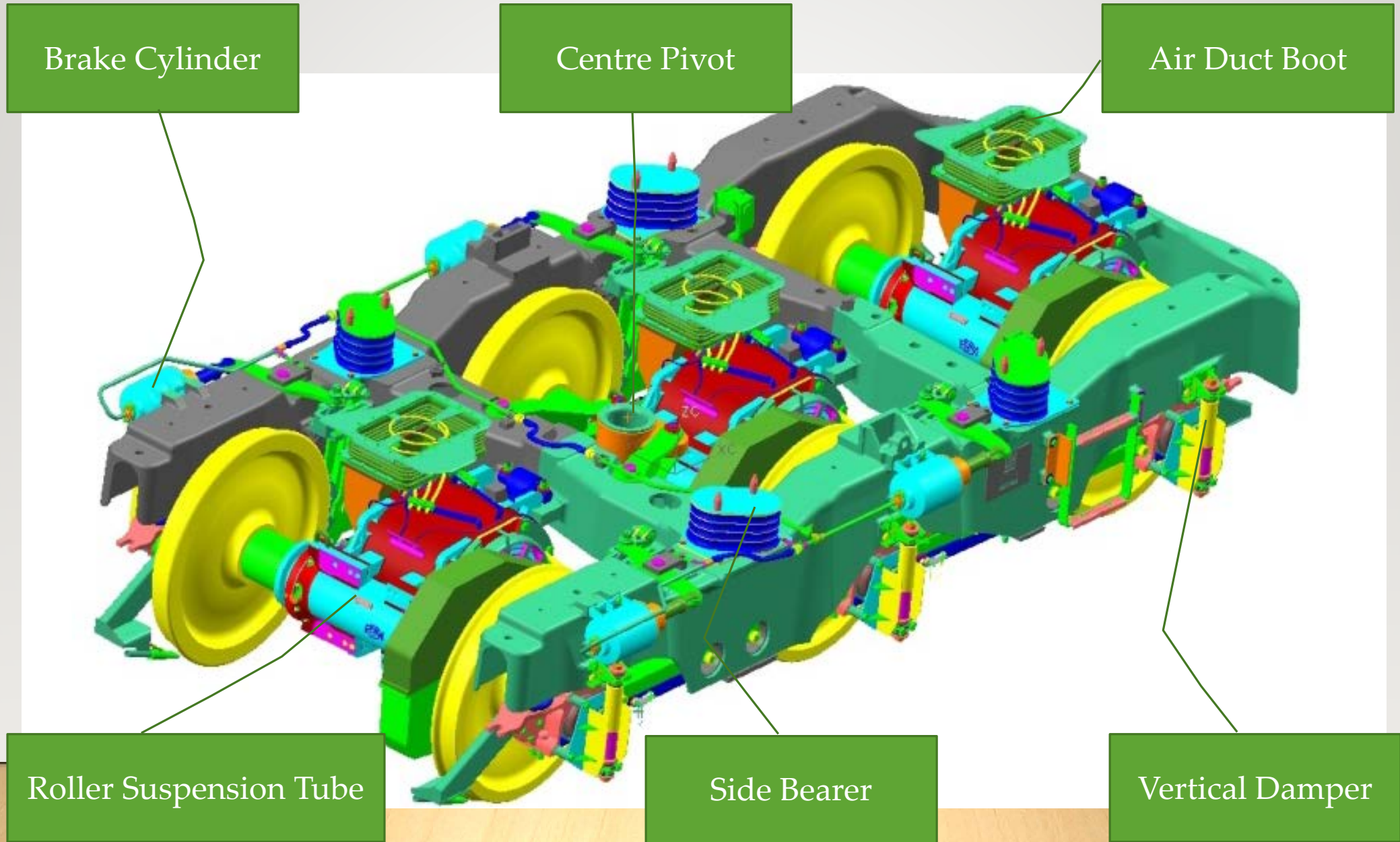
HHP Locomotive's Bogies

CONSTRUCTION AND FEATURES

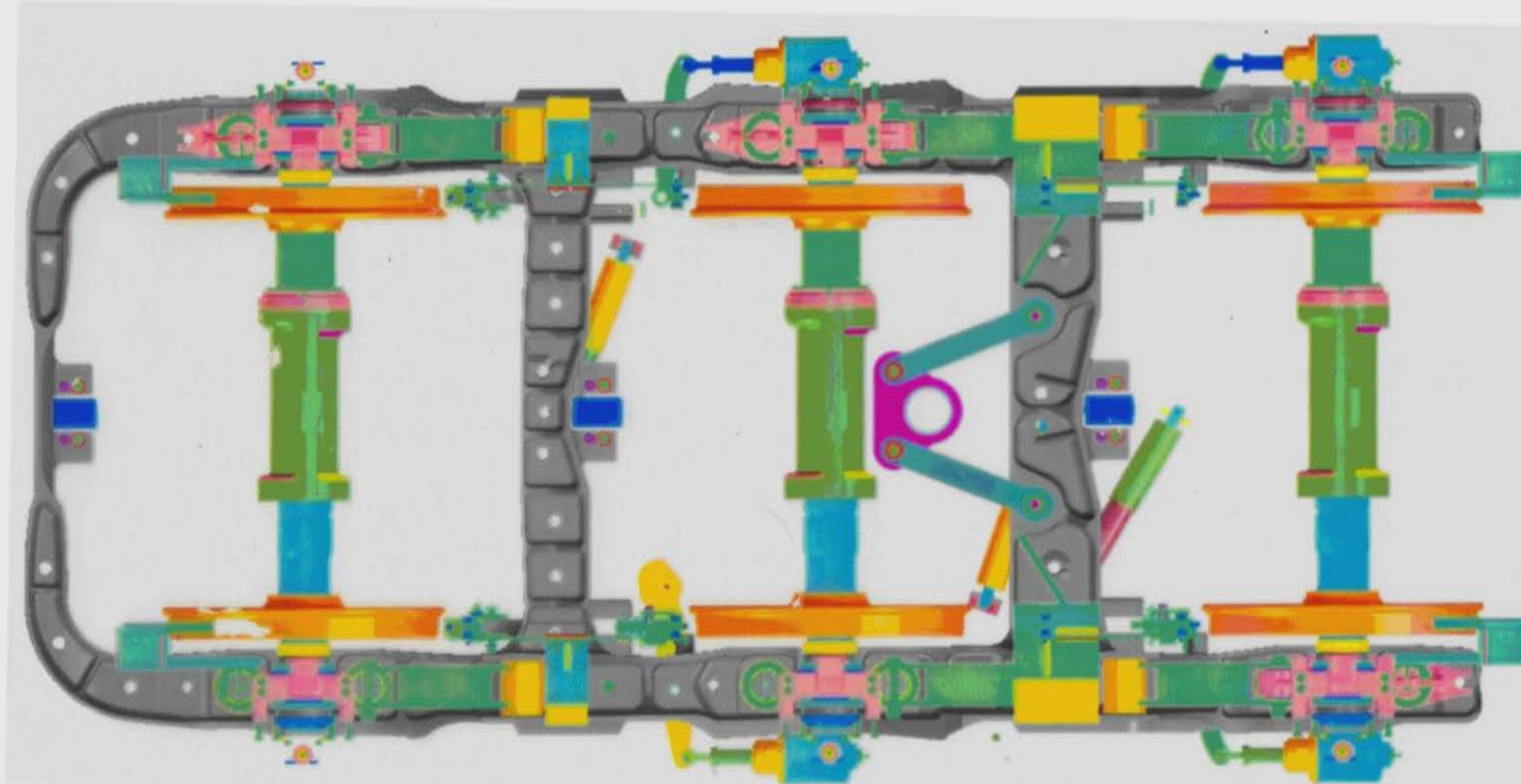
2 Comparison of Bogies

SN	DESCRIPTION	WDM2/ WDM3A	WDG2/ WDG3A	WDP3A	WDG4	WDP4
1	Bogie	Cast steel	Fabricated	Fabricated	HTSC	HTSC/ Fabricated
2	Tractive Effort (T)	30.4	40.6	32.8	53	27.55
3	Axle Load(T)	18.8	20.5	19.5	21	19.5
4	Gear Ratio Pinion: Bull Gear	18:65	18:74	22:61	17:90	17:77
5	Max Speed (KMPH)	120	105	160	100	160 / 135
6	Weight transfer to wheels	Centre Pivot 60%, Side Bearer @20% each	4 Nos. side bearers @25% each		4 Nos. Side Bearers @25% each	4 Nos. Side Bearers @25% each

3 Pictorial view of HTSC bogies



4 Side & top view of HTSC bogies



Salient features

- Overhauling required after
 - 6 years or 14 lakh Kms for pass services.
 - 6 years or 10 lakh kms for freight services.
- Low flange force for longer wheel life.
- Cartridge bearing in axle boxes for higher reliability & service life.
- Light weight, high performance three phase ac traction motors with better reliability.
- Low un-sprung weight by use of lighter traction motors.
- Provision of wheel creep control to maximize adhesion.

6 Salient features (contd.)

- Rubber compression springs
 - Designed to adapt seat provided on the bogie.
- Suspension of traction motor.
 - By nose link fitted with rubber bushings.
 - Needs lesser maintenance as compared to rubber sandwiches used in ALCO locos.
- Provided with single composite type brake shoes.

7 | Maintenance free

- Elimination of wearing parts
 - Pedestal & axle box liners,
 - Centre pivot liners,
 - Friction snubbers etc.
- No pedestal liners on bearing adaptor.
- Use of wear resistant liners
- Cartridge bearing
 - Fit & Forget
- Hydraulic damping – less attention required.

8 | Weight transfer in HTSC bogies

- Locomotive body weight
 - Transferred directly to the bogie frame
 - Through four rubber “Compression” springs.
- Bogie frame supported on axles
 - through twelve single helical coil springs,
 - provides ride quality.

9 | Transfer of forces in HTSC bogies

- Traction Rods transfer
 - Braking forces
 - Traction forces
 - From wheels to frame.
- Centre pivot
 - No vertical load
 - Only for transfer of
 - Traction and braking forces.

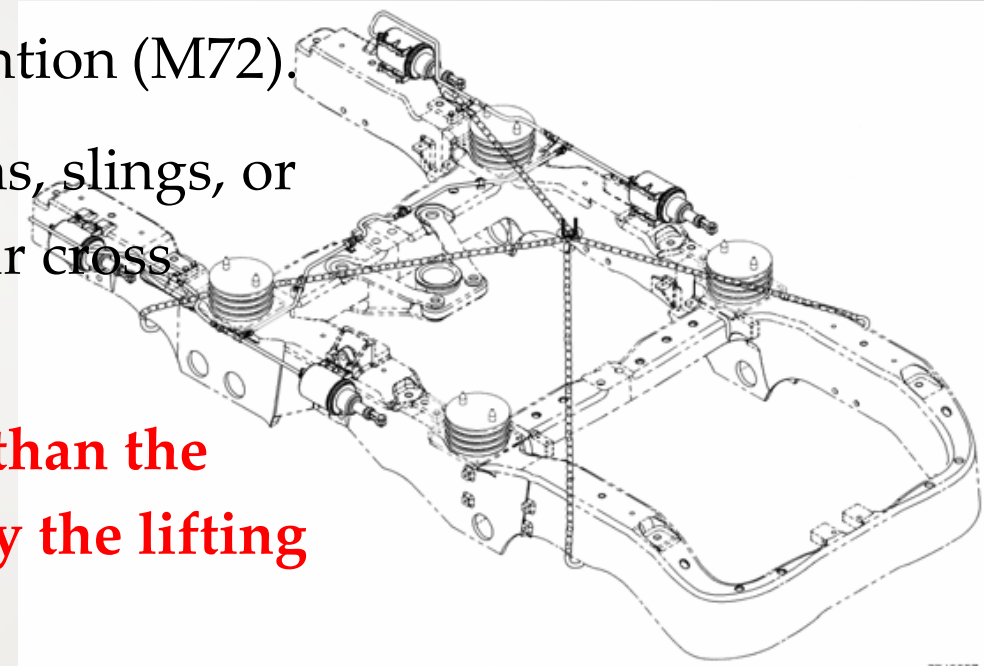


10 | Suspension in HTSC bogies

- Soft primary suspension
- Stiff secondary suspension
 - Controls pitching
- Less center pivot height
 - Lowers the Centre of Gravity.
- Traction motors
 - Oriented to the same side
 - Suspended by nose links

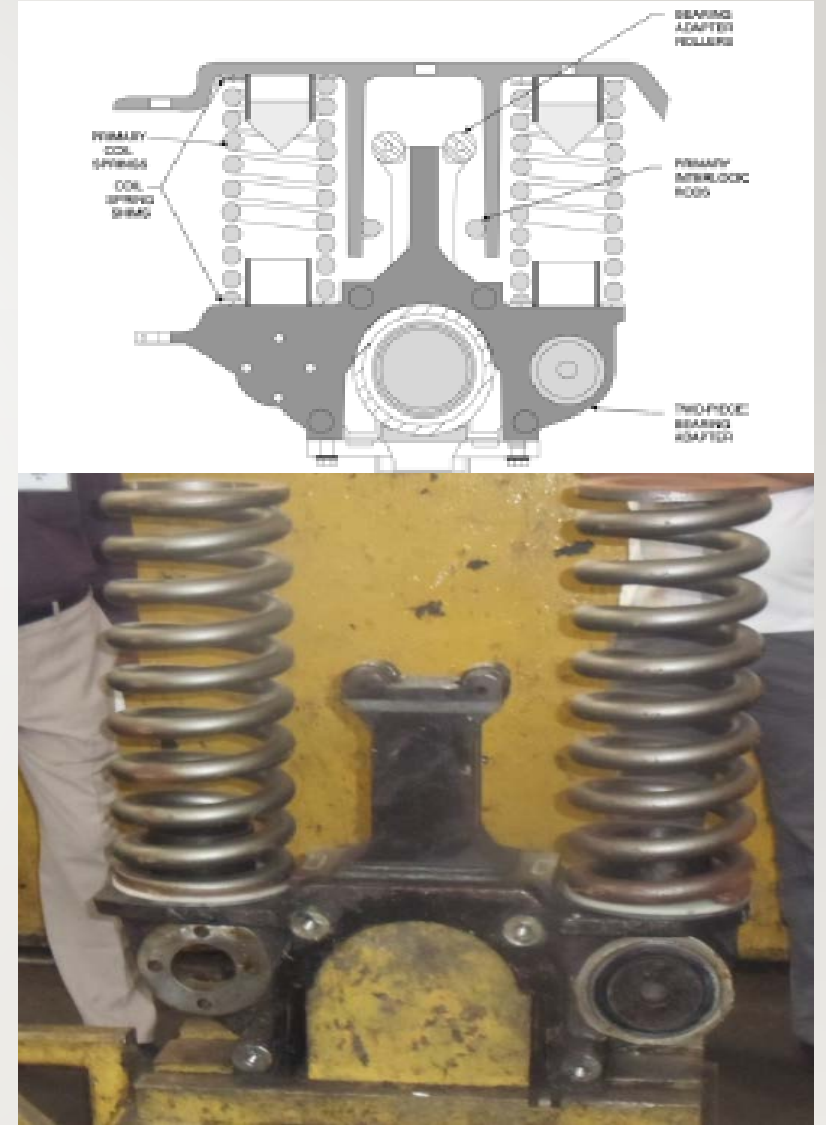
11 Bogie frame

- Should be cleaned regularly.
- Cleaned in IMMERSION tanks during major attention (M72).
- When lifting the HTSC-B1 bogie ensure that chains, slings, or other lifting devices are NOT connected to the rear cross member (transom) of the bogie frame.
- **(HTSC –B1) bogies have a thinner cross section than the HTSC bogie in this area and may be damaged by the lifting forces.**
- The frame has cast markings identifying the areas that are not to be used for lifting.



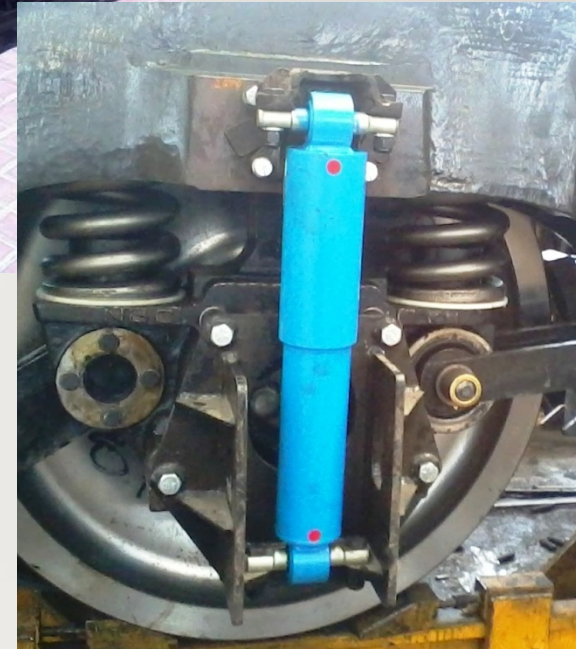
12 | Axle journal bearing

- Cartridge type tapered roller bearings
- Integrated bearing adapter.
- Normal temp 56°C above ambient
- Not allowed above 93°C .



13 Vertical Hydraulic Dampers

- Six nos. provided in primary stage between axle and bogie frame.
- Should be fitted as per markings.
- **Frequent cases of breakage of mounting bracket holding bolts.**
- These bolts should be torqued properly to prevent line troubles.
- **DLW vide L/No. dlw.m.65.154.1 dtd 28.11.2013 have advised to weld the upper bracket with the bogie frame.**



14 | Top & Bottom Bracket fixing

CONVENTIONAL ARRANGEMENT



MODIFIED ARRANGEMENT



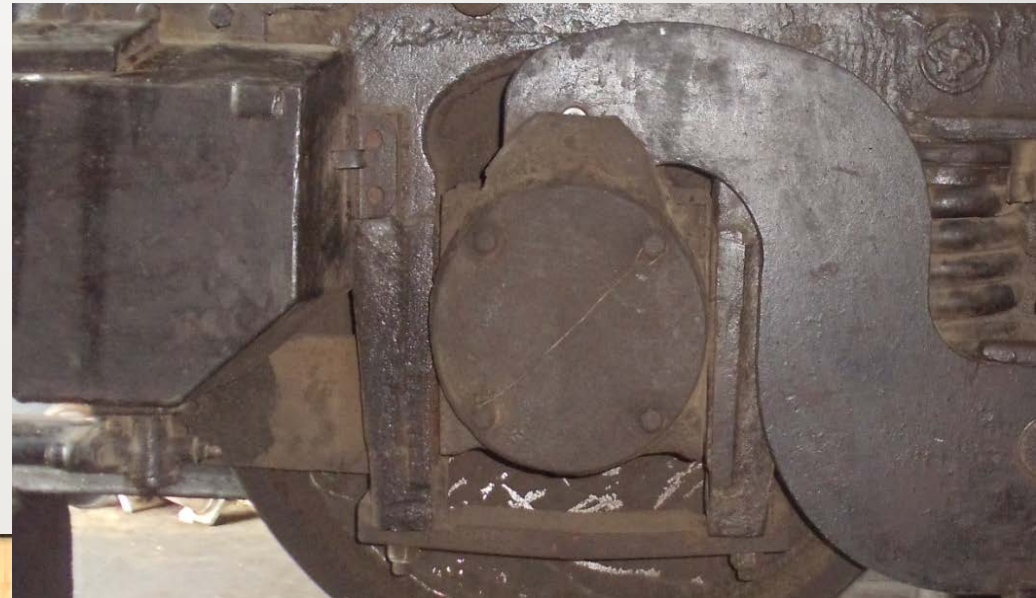
15 | Yaw Dampers

- Two nos. provided in secondary stage between bogie frame and the loco under frame.
- Oriented to provide damping both in lateral and yaw modes.



16 | Traction Rods

- Guides Wheel sets
- Helps in reducing wheel flange forces.
- Transmit
 - Traction forces &
 - Braking forces
 - From the bogie frame to wheels.



17 Traction motor gear case

- Any loss of oil will directly cause failure of traction motor assembly.
- There should be no oil leakage.
- Approx Requirement
 - 7.5 ltrs (G4)
 - 8.5 ltrs (P4)
 - SERVO SYNGEAR 460 RR (IOC make)



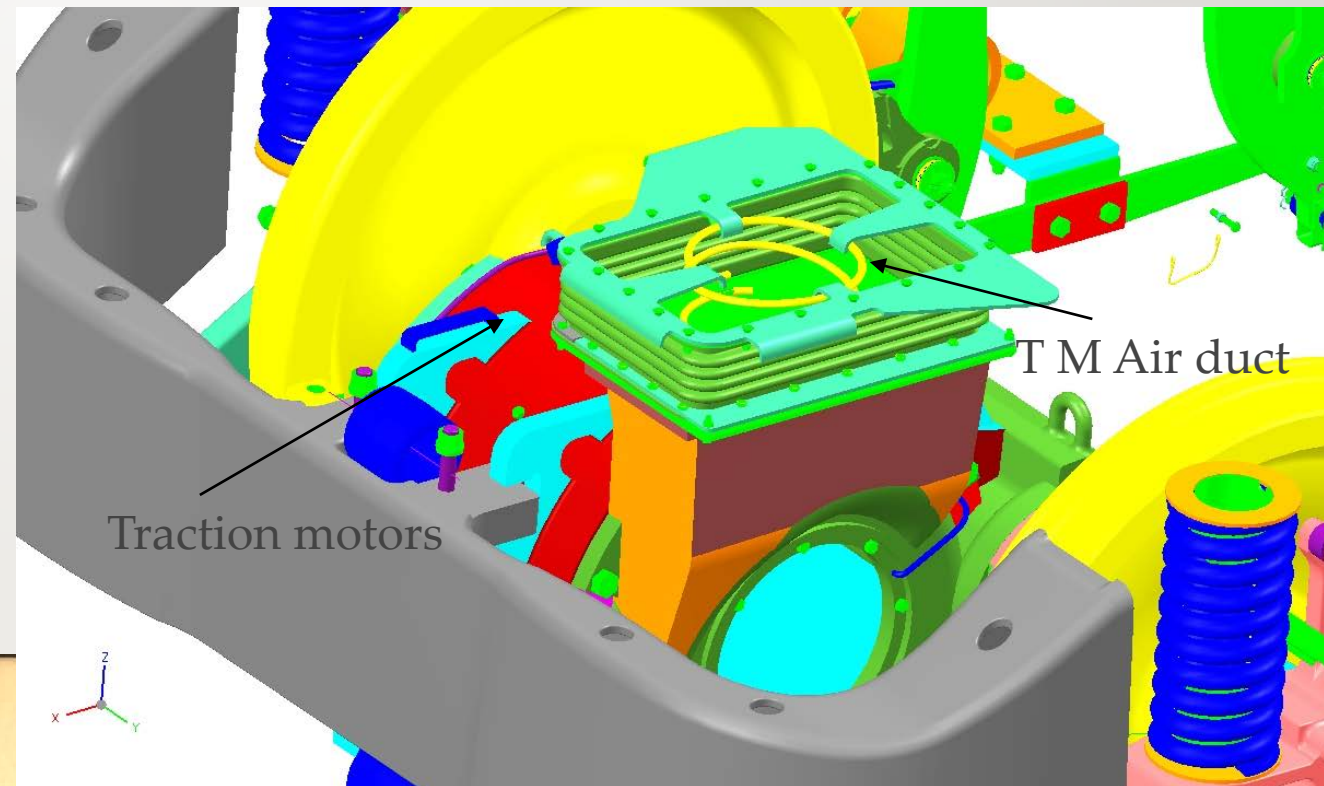
18 | Traction motor nose links

- Suspend the traction motors
 - On drive axles and
 - With the bogie frame
- Facilitates in position removal of wheel and motor assembly
 - DROP PIT TABLE required.
 - Not possible in Alco Bogies.
- Special LOCK BOLTS are used for securing



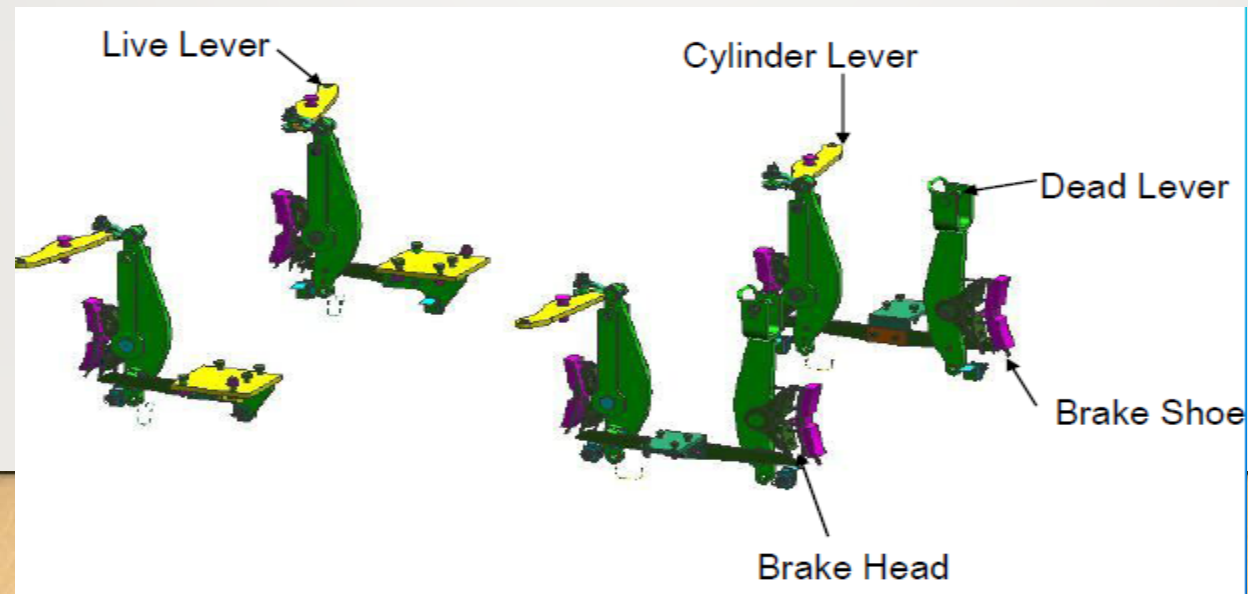
Traction motor cooling arrangement

- Traction motors are air cooled.
- Traction motor blower is used to supply filtered air to all six motors.
- Filtered air comes from under frame air gallery thru T M Air duct assembly fitted on opening at traction motor top.
- Top of T M Air duct assembly is having a non metallic wear plate rubbing with under frame bottom.
- A compression spring is provided in air duct assembly to push up wear plate towards under frame.



Brake Rigging Arrangement

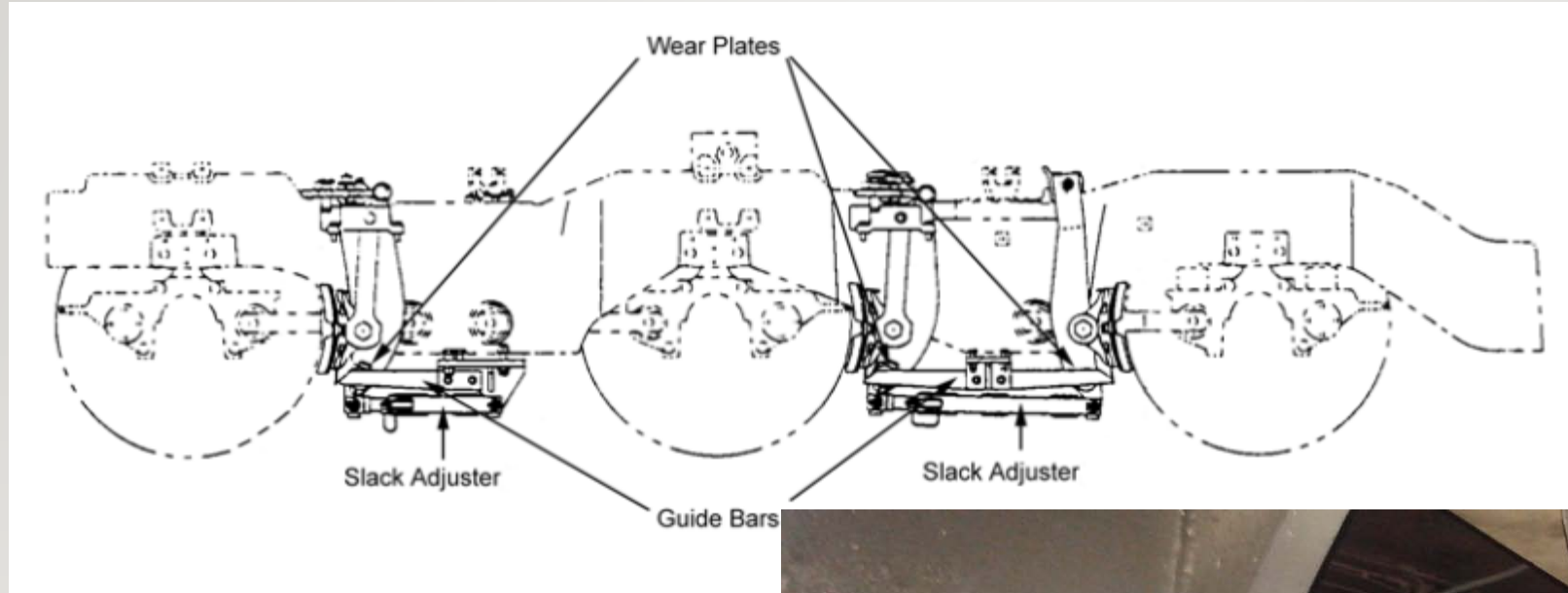
- Conventional type brake rigging is provided with single shoe per wheel arrangement with composite brake blocks.
- Manual type slack adjusters are provided to adjust brake shoe-wheel gap.
- DLW vide L/No. dlw.m.65.262 dtd 26.11.2013 have advised certain actions for preventing breakage of lever assembly and slack adjusters.



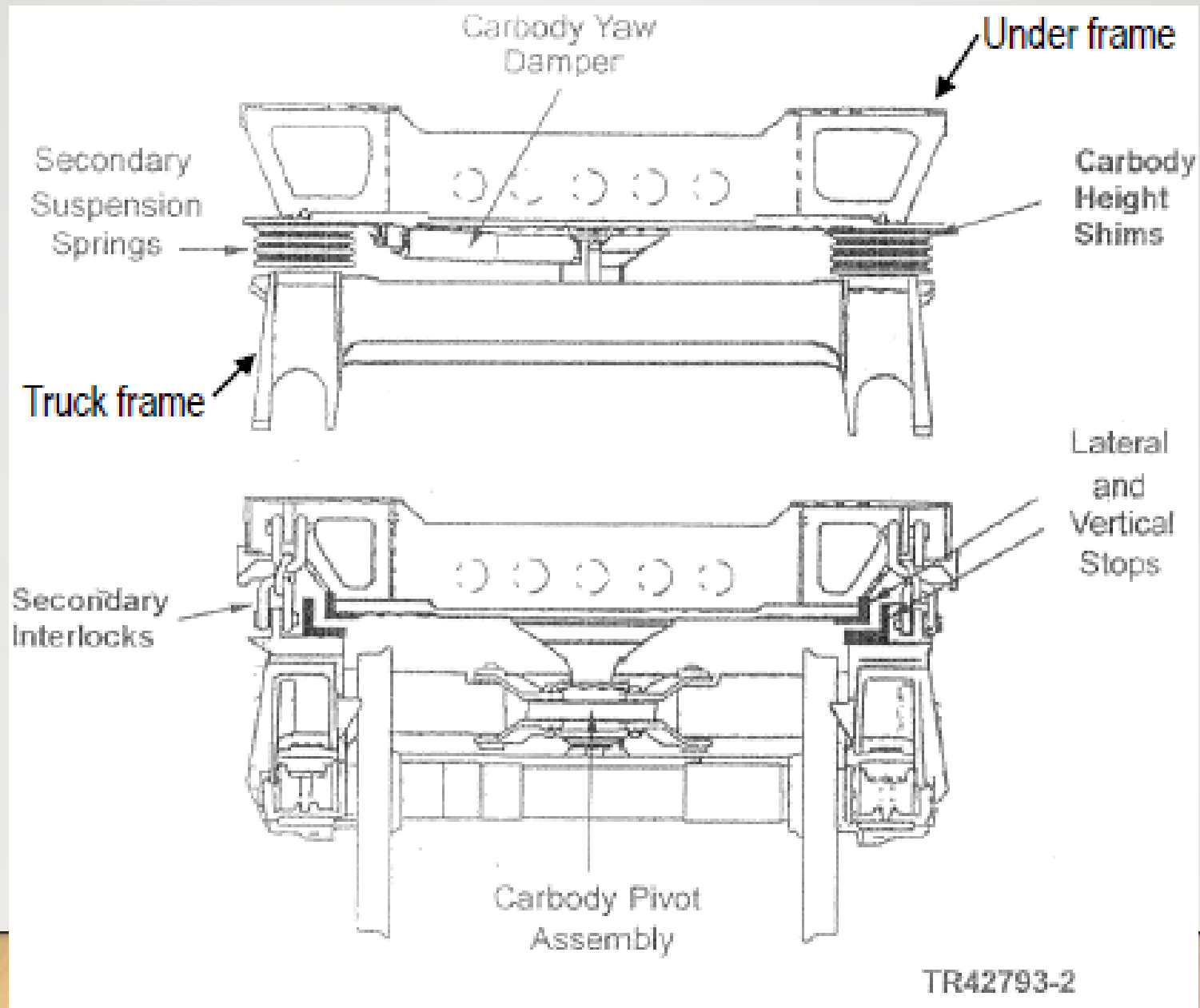
Brake rigging stabilizing bars

- Provided on the underside of the bogie frame at the “live” and/or “dead” block lever location.
- A 6.4mm (0.25”) thick X 87.5 mm (3.5”) diameter Nylon alloy wear plate is bolted to each brake lever which mates to a spring steel stabilizing bar.
- Maintains brake shoe to wheel alignment.
 - Reduces possibility of brake blocks climbing on wheel flange.
- The wear plates should be replaced when the thickness is half of the original, or 3.2mm (0.125”).

22 Brake rigging stabilizing bars

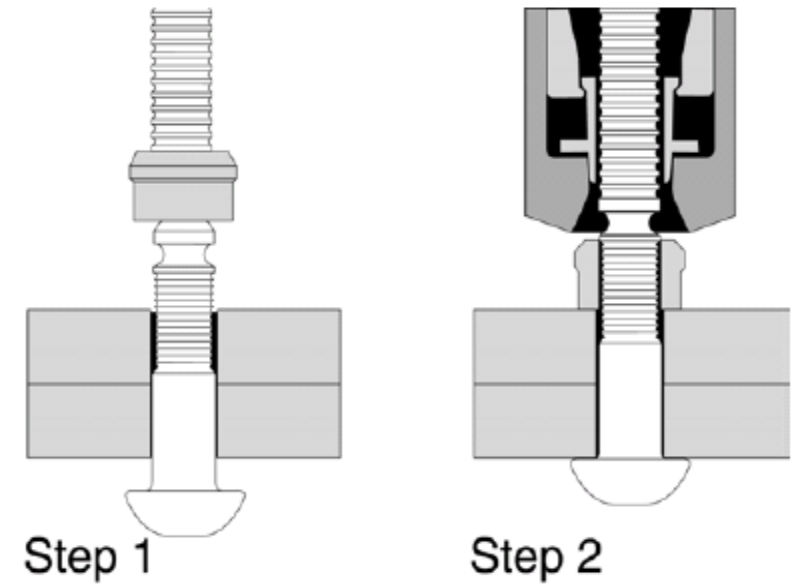


Cross section of locomotive



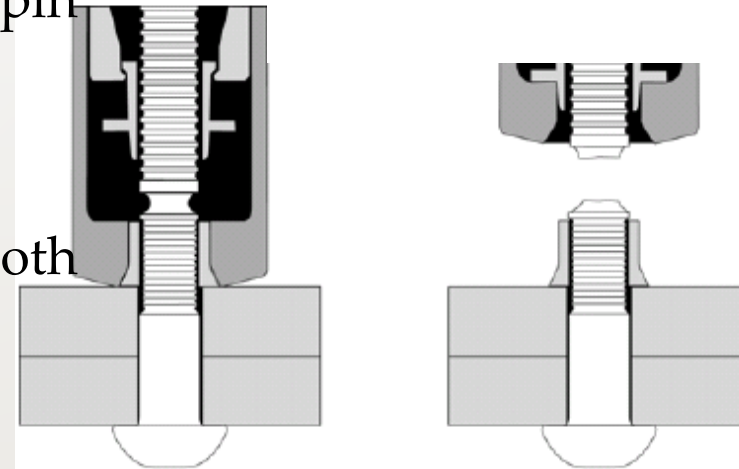
24 Lock bolts (Huck Bolts)

- Used on this bogie at critical locations to make it a ZERO FAILURE unit (on the account of loose fasteners).
- Locations where used:
 - Car body traction rods at the bogie end,
 - Carboy traction rod connection at pivot pin end,
 - Axle traction rod connections (both ends) &
 - Traction motor nose link connections (both ends).



Step 1
The pin is inserted into the prepared hole and the smooth bore collar is placed on the pin.

Step 2
The installation tool is applied to the pintail. When the tool is activated, the jaws in the nose assembly pull on the pintail and the nose anvil pushes on the collar to remove any gap.

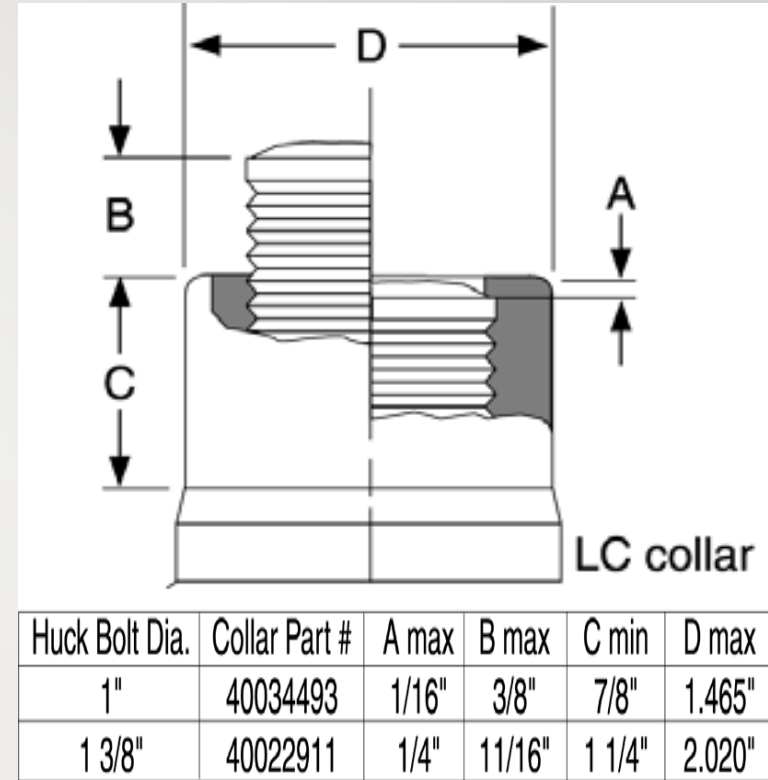


Step 3
The nose anvil starts to swage the collar into the lockgrooves on the pin. Continued swaging causes the collar to lengthen and develop clamp.

Step 4
When swaging of the collar into the lockgrooves is complete, the pintail separates from the pin which completes the installation cycle.

25 | Precautions needed while applying lock bolts

- Ensure that hose connections are tight, and that hand tool and power rig connections are secure and proper.
- Do not stay directly in line with the lock bolt during installation.
- Stop tool operation in case of breakage or wrong adjustment, or if hoses are leaking or cables damaged.
- Ensure that the final measurements are as specified.



WDG4-12227 fitted with fabricated bogie frame (Fab-I)

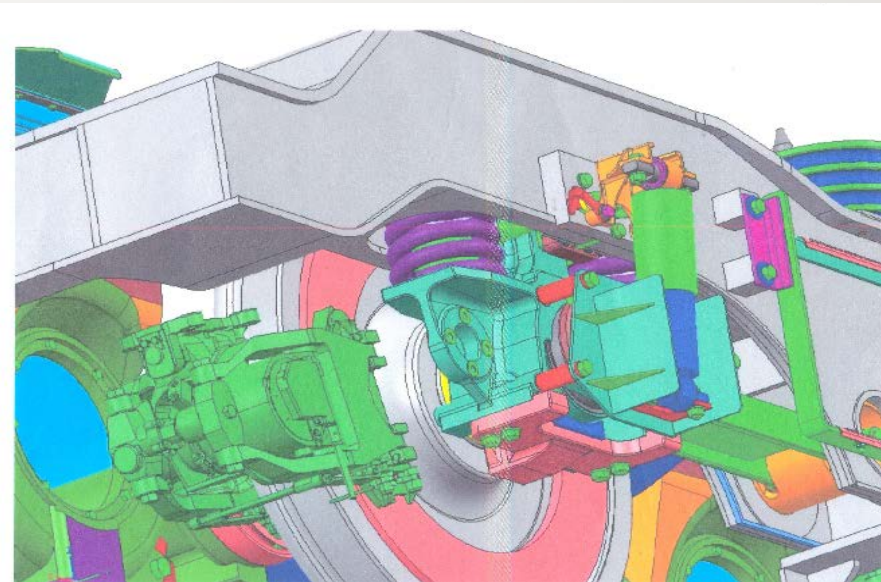
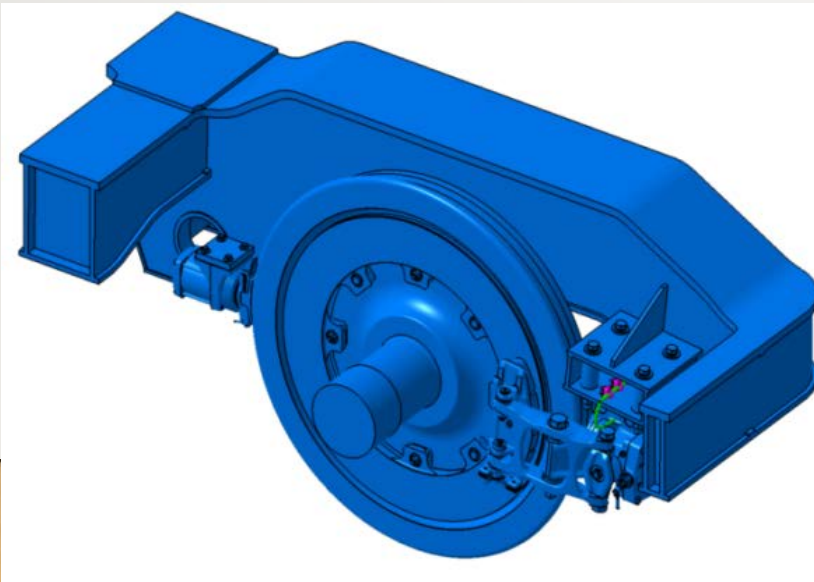


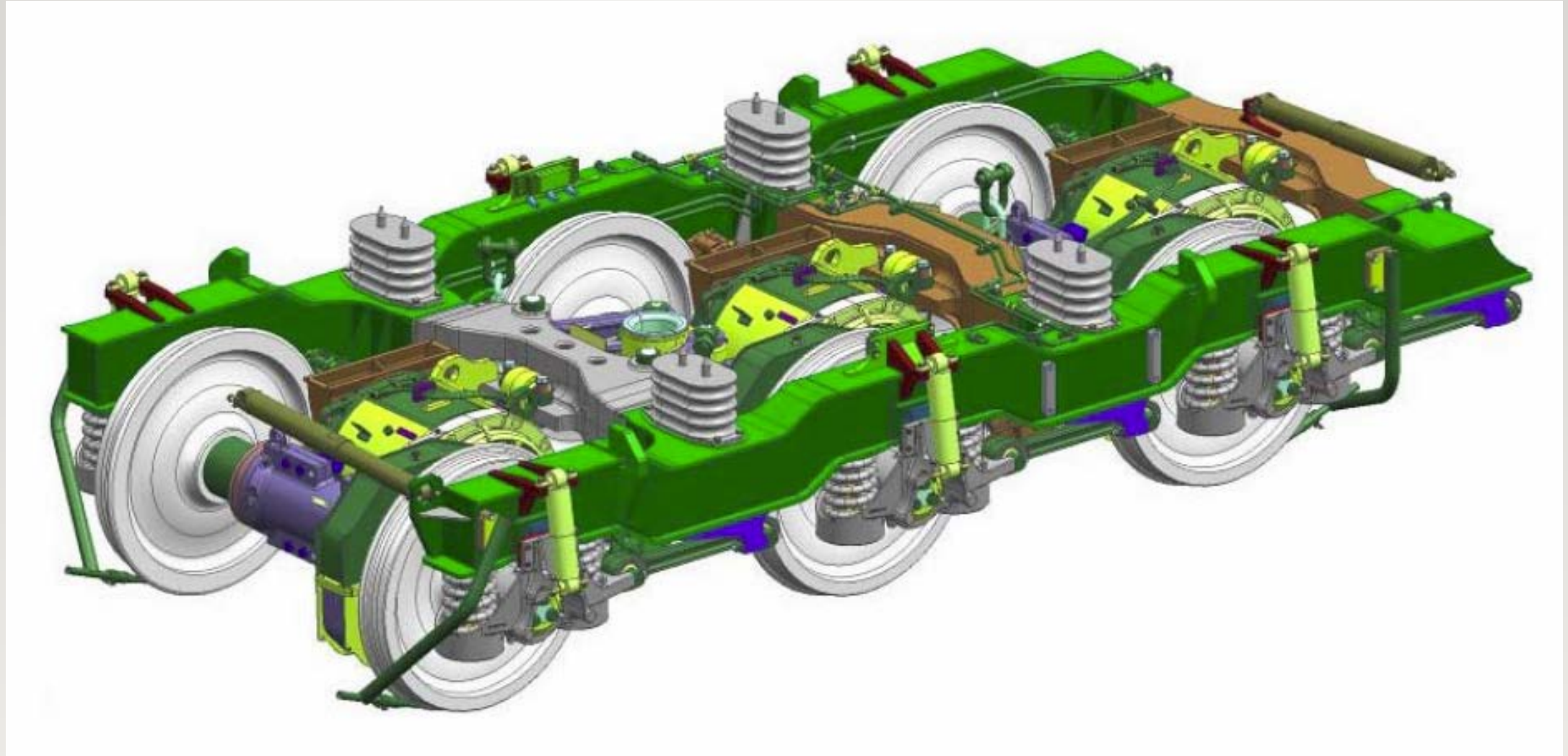
1. Fab-I bogie frames developed & fitted in loco no. WDG4-12227 (Wt. 5.0 T)
2. Fab-II (lighter version of Fab-I) (Wt. 4.6 T) has been developed & are being fitted on WDP4D locomotives.



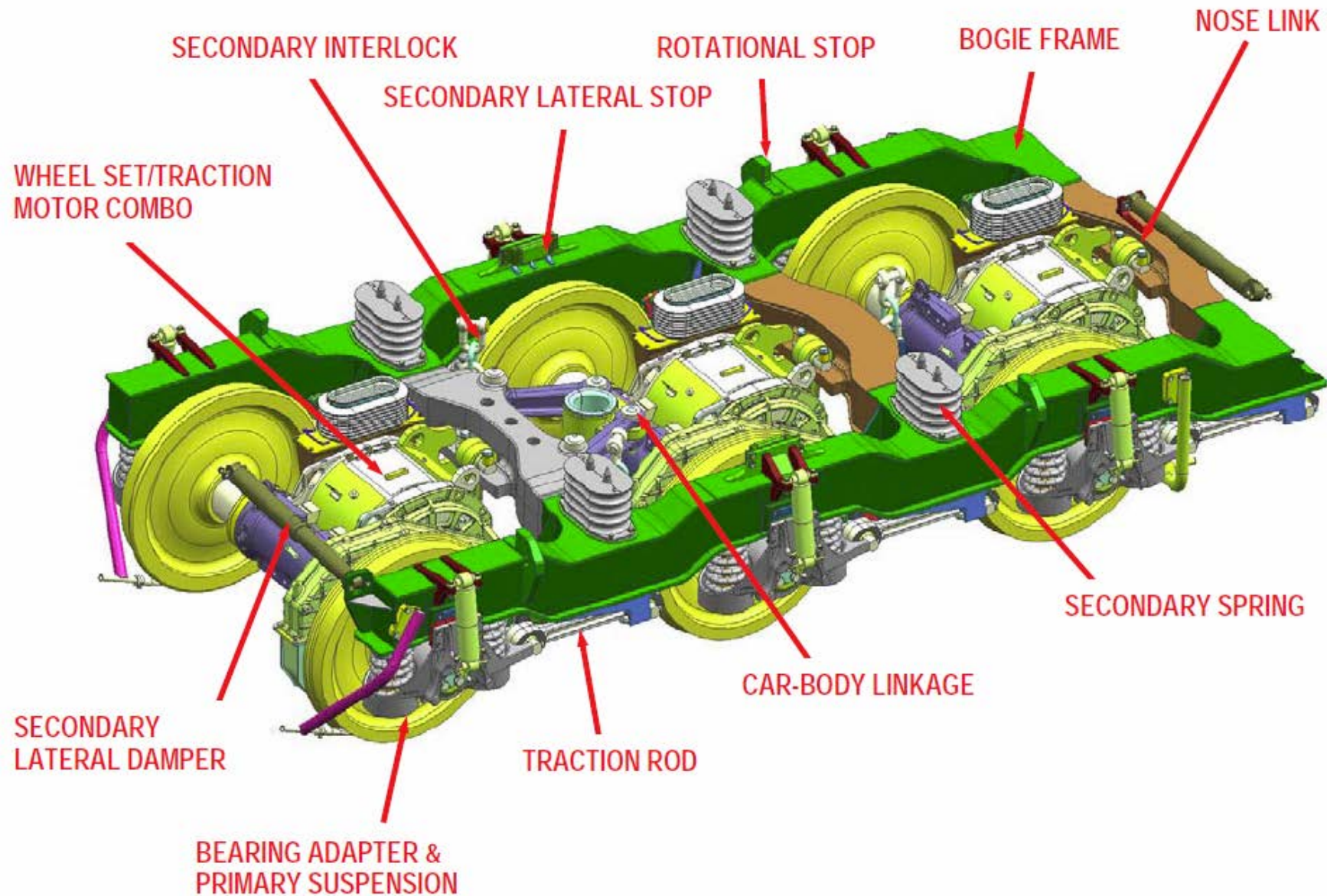
Disc brake systems for WDP4/WDP4B locomotives

- Low thermal load on wheel during braking , result in increased Wheel Life
- High speed operation
- Reducing braking distance
- High reliability & low Maintenance
- Elimination of conventional Brake Rigging Problems
- Loco no WDP4D-40122 dispatched to TKD shed on 13.07.2013

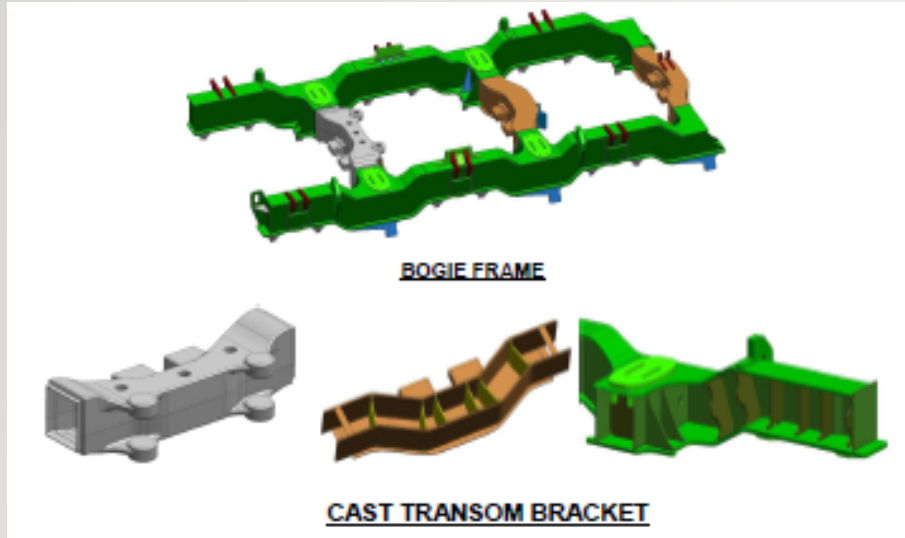




Details of HTCF Bogie

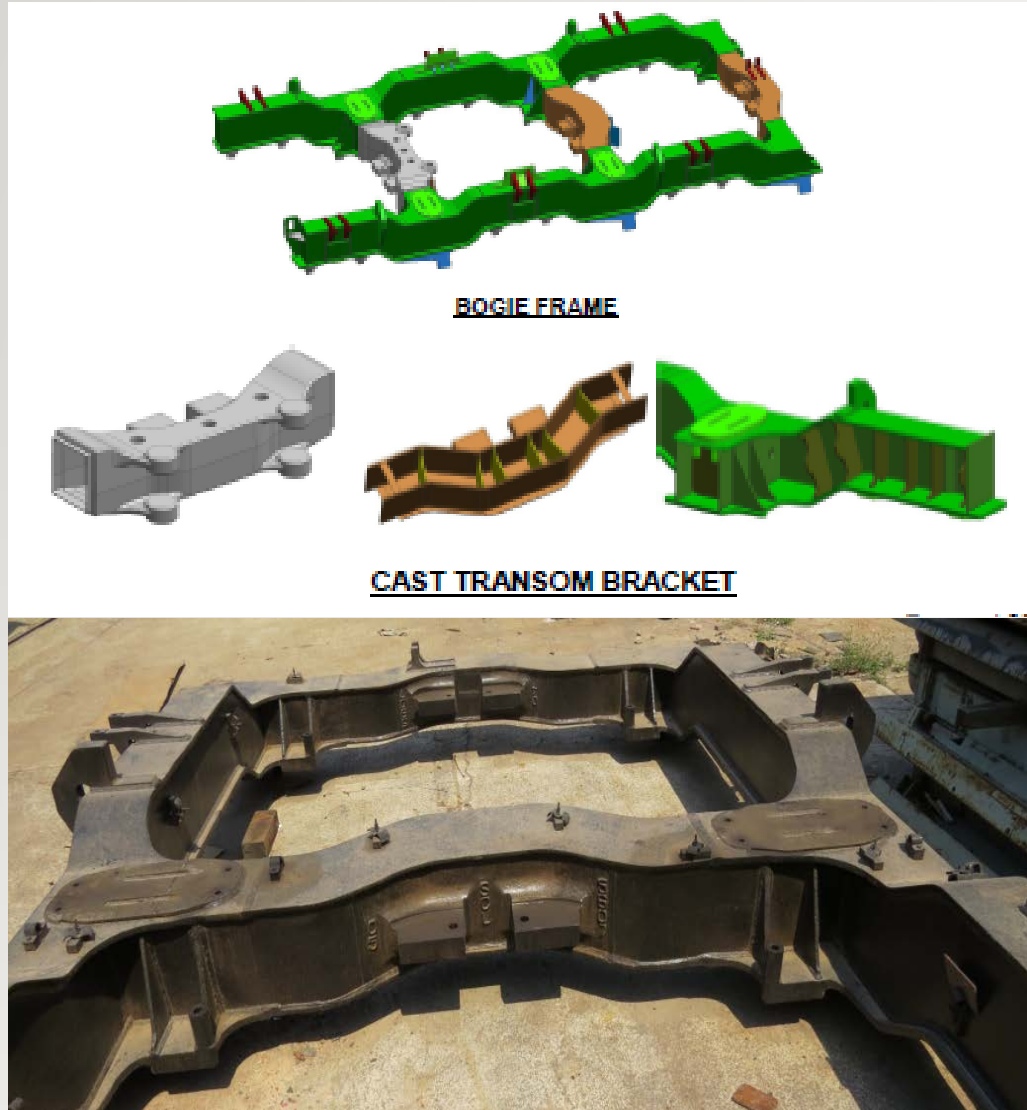


30 Hybrid Bogie Frame



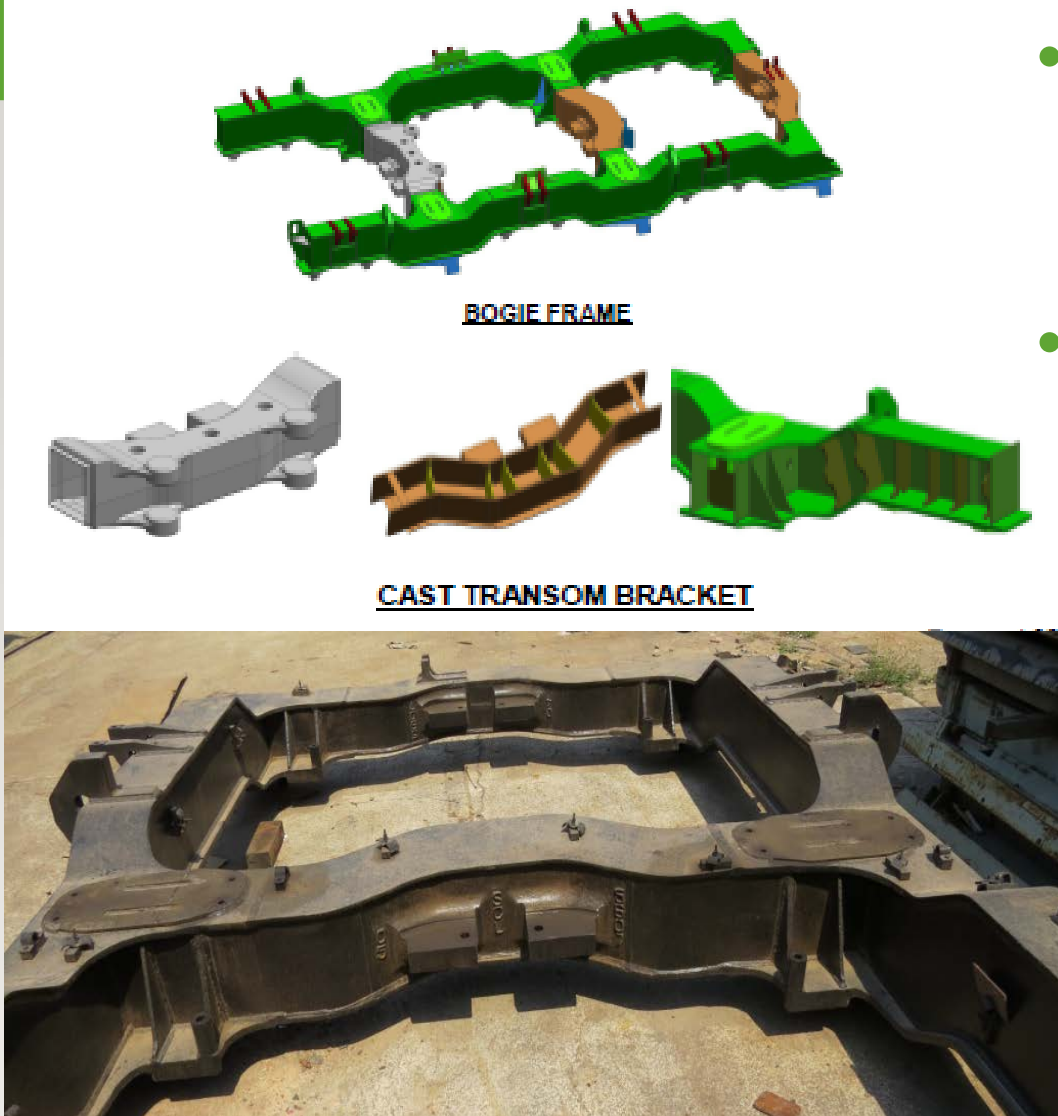
- The WDG5 locomotive is equipped with two High Tensile Cast Fabricated (HTCF) bogie frame assemblies.
- Supports the weight of the locomotive and provides the means for transmission of power to the rails.
- The rigid steel fabricated frame, utilizes a bolster-less secondary suspension system.
- All longitudinal traction and braking loads are transferred from the bogie assembly to the locomotive under-frame through the car-body linkage system.

31 Hybrid Bogie Frame



- The bogie is designed to provide high reliability, longer overhaul cycle and extended maintenance intervals.
- **Design features**
 - This is a hybrid bogie frame consisting of fabricated longitudinal beams & cast transoms (cross members).
 - Pivot transom is a fully casting part while other middle & end transoms are partially cast & welded with longitudinal beams during fabrication.
 - All structural components are made from High Strength Low Alloy steel EMS 93 with yield strength of 345 MPa (50KSI) or equivalent cast steel EMS26.

32 Hybrid Bogie Frame - Advantages



- **Light weight design:**

- Weight savings and better dynamic performance.

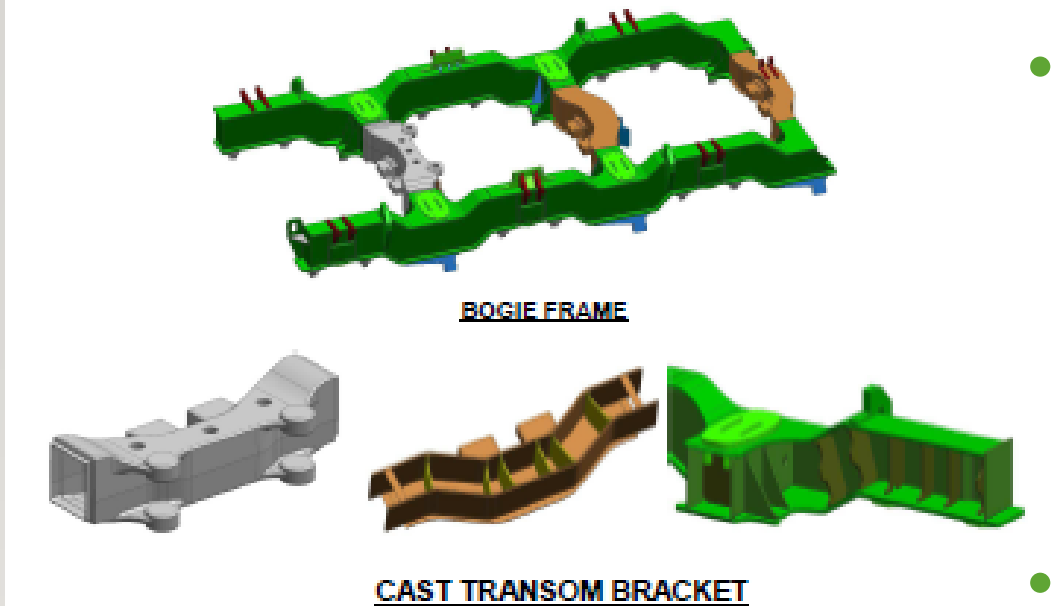
- **Ease of assembly:**

- Less work for unitized brake application.
- Bushings are not pressed in the bogie frame and bearing adapters.

Maintenance improvements:

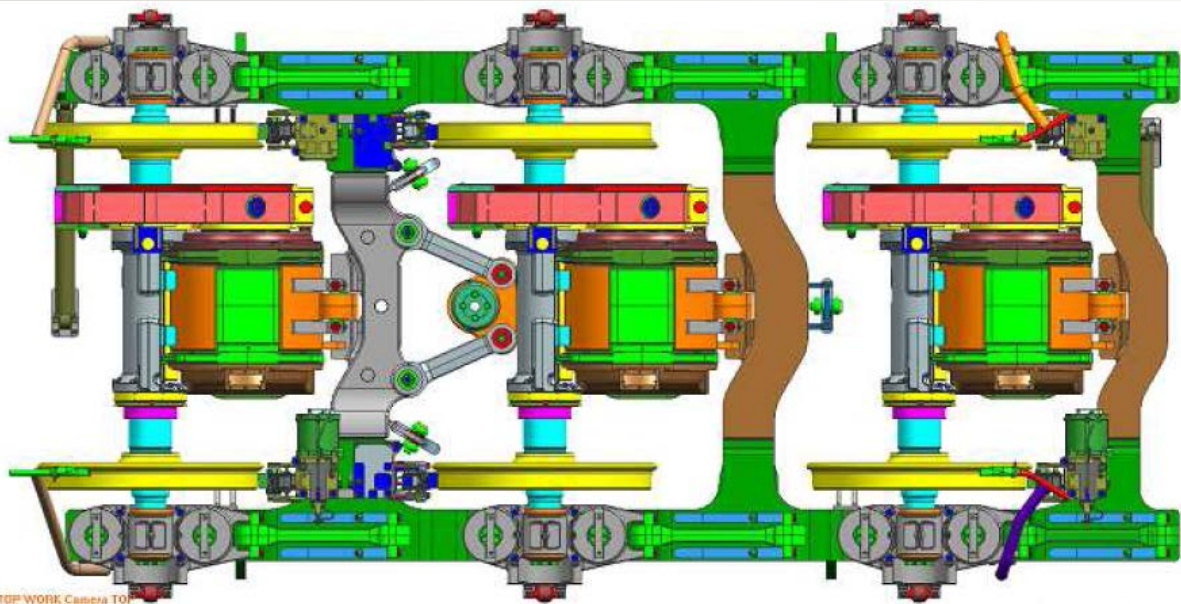
- Reduced labour for unitized brake application and replacement; replacing traction rod bushing can be done at bench operation; no need for blocking to lift locomotive.

33 Hybrid Bogie Frame - Advantages



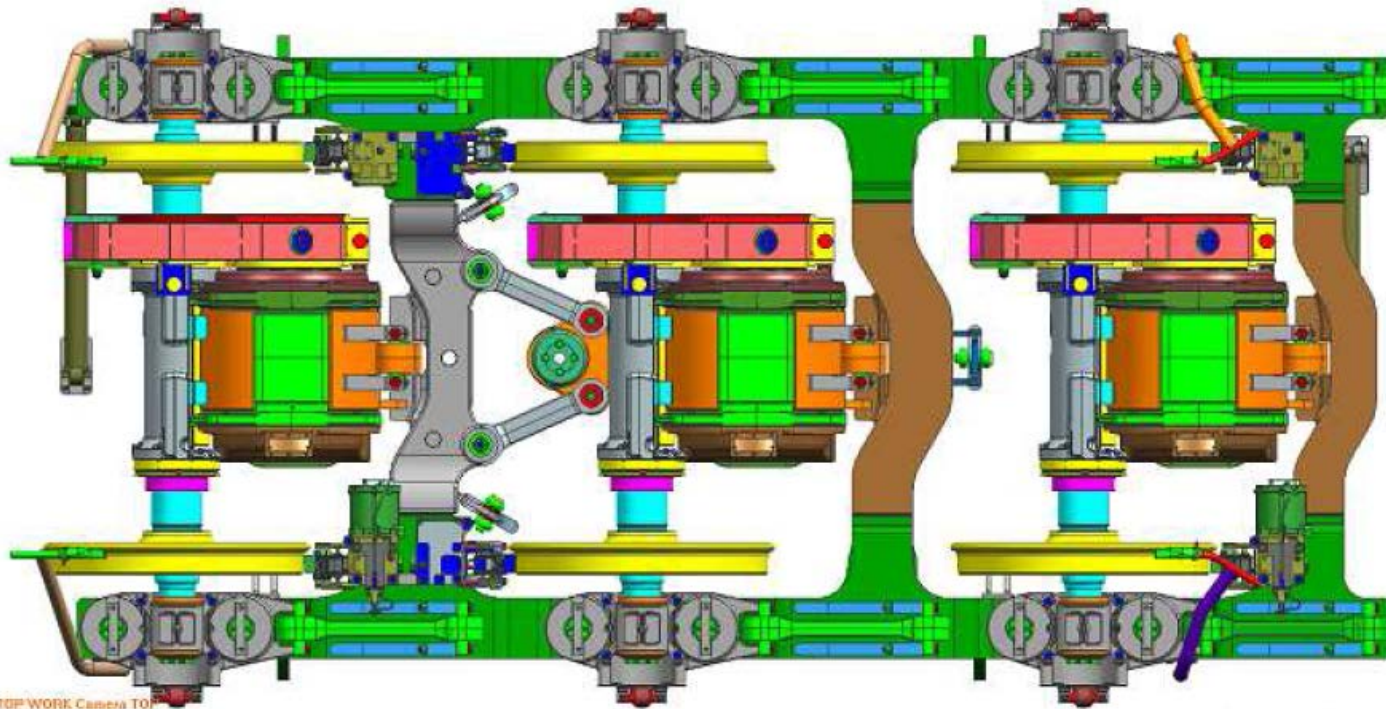
- **Performance enhancement:**
 - Better ride performance and higher stability allowing for potential high speed passenger locomotive application improved traction motor ventilation from fixed-fixed air duct arrangement.
 - **Enhanced reliability:**
 - Lower track induced accelerations help to reduce components failures caused by vibration.
- Adaptability to WDG4 locomotive:**
- Minimum modifications

34 | Tread Brake Unit



- Tread Brake Units are bogie mounted mechanical devices used to provide braking force to the locomotive.
- The brake unit converts pressurized air into mechanical movement and force on the brake shoe against wheel tread.
- Unitized tread brakes acting on one composition brake shoe per wheel provide the braking power for the locomotive.
- The tread brake units utilize integrated slack adjusters that compensate the full amount of wheel wear as well as the brake shoe wear.

35 | Tread Brake Unit

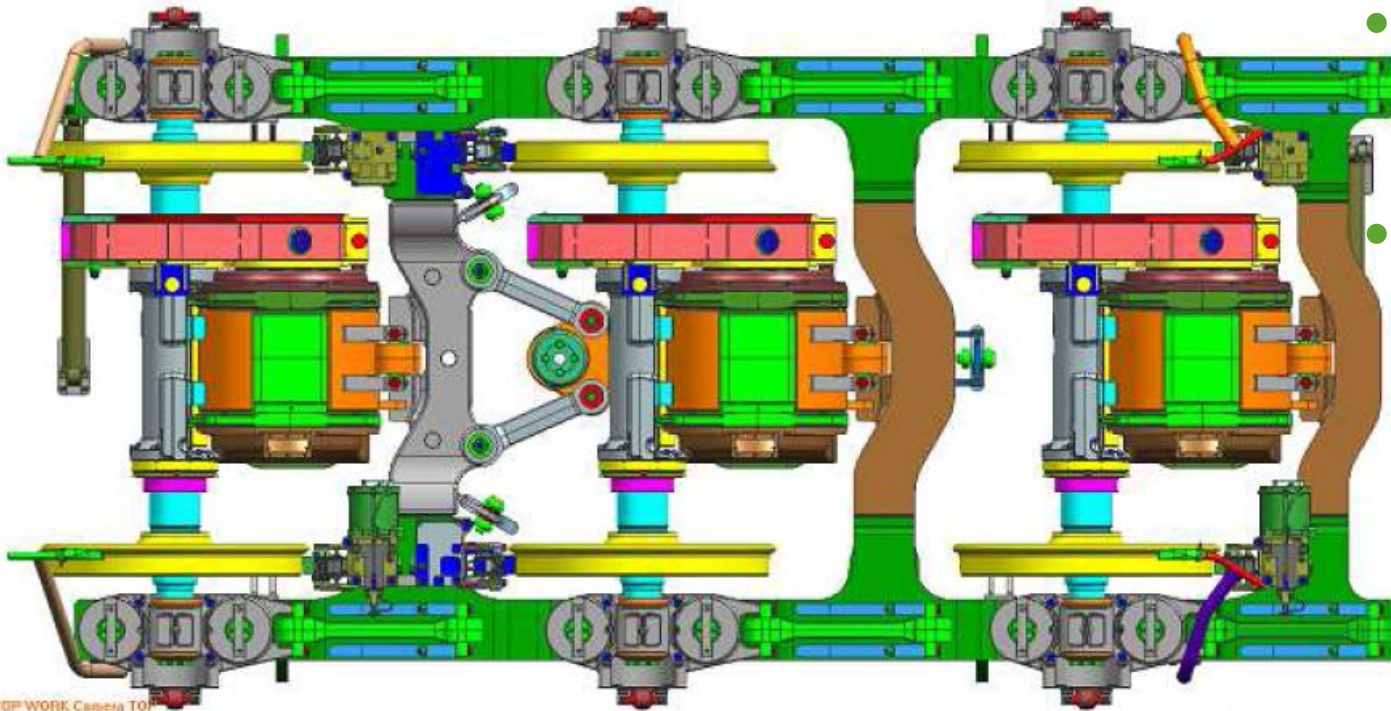


- The unitized pneumatically powered tread brake unit consists of a brake cylinder, a transmission mechanism and a slack adjuster.
- Units having an attached spring actuator can be used both as service brakes and as parking brakes.
- The spring actuator is released by compressed air allowing all the parking brakes on the locomotive to be applied and released centrally from the driver's cab.

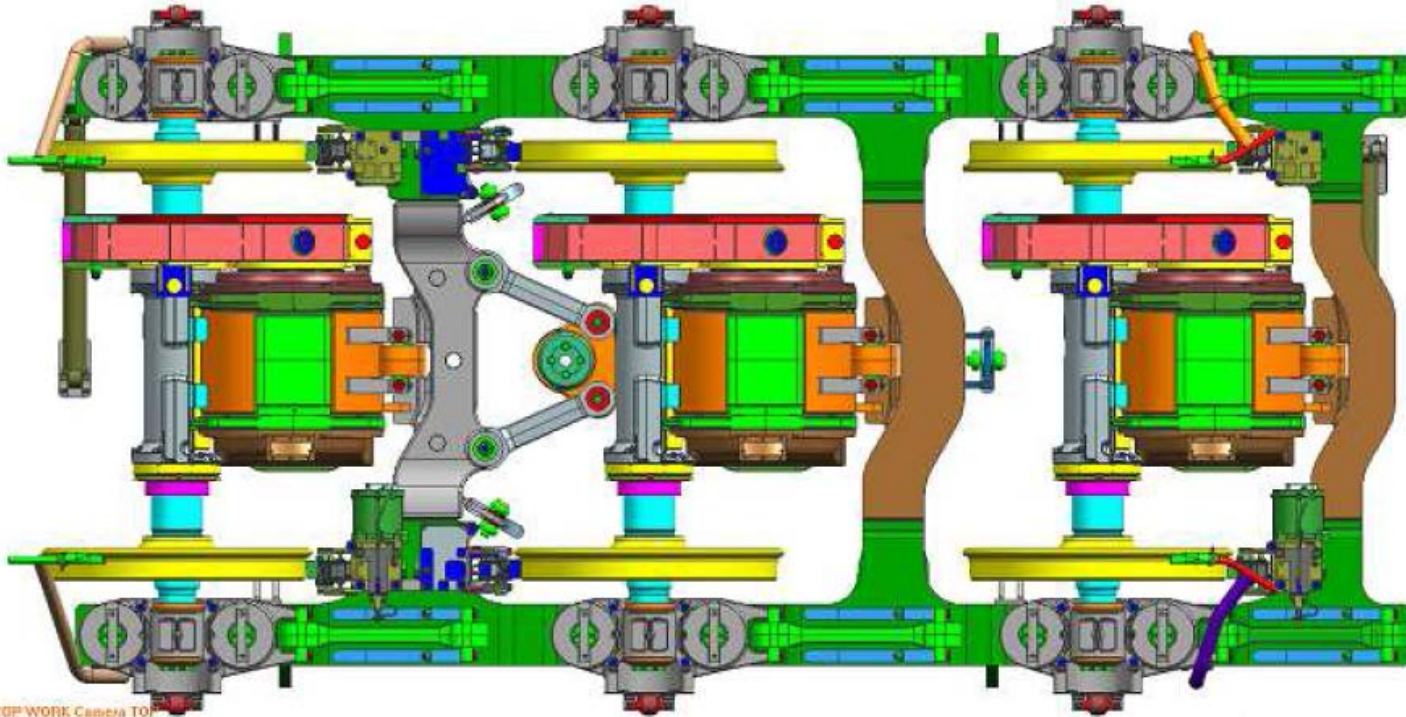
36 Tread Brake Unit – Main characteristics



- 1 Unitized Tread Brake unit per wheel with 1 brake head and 1 brake shoe.
- Brake shoe is of K-Type composite material
- All units are top mounted allowing easy removal and installation
- Parking brakes are provided in end axles of each bogie



37 | Tread Brake Unit – Main characteristics

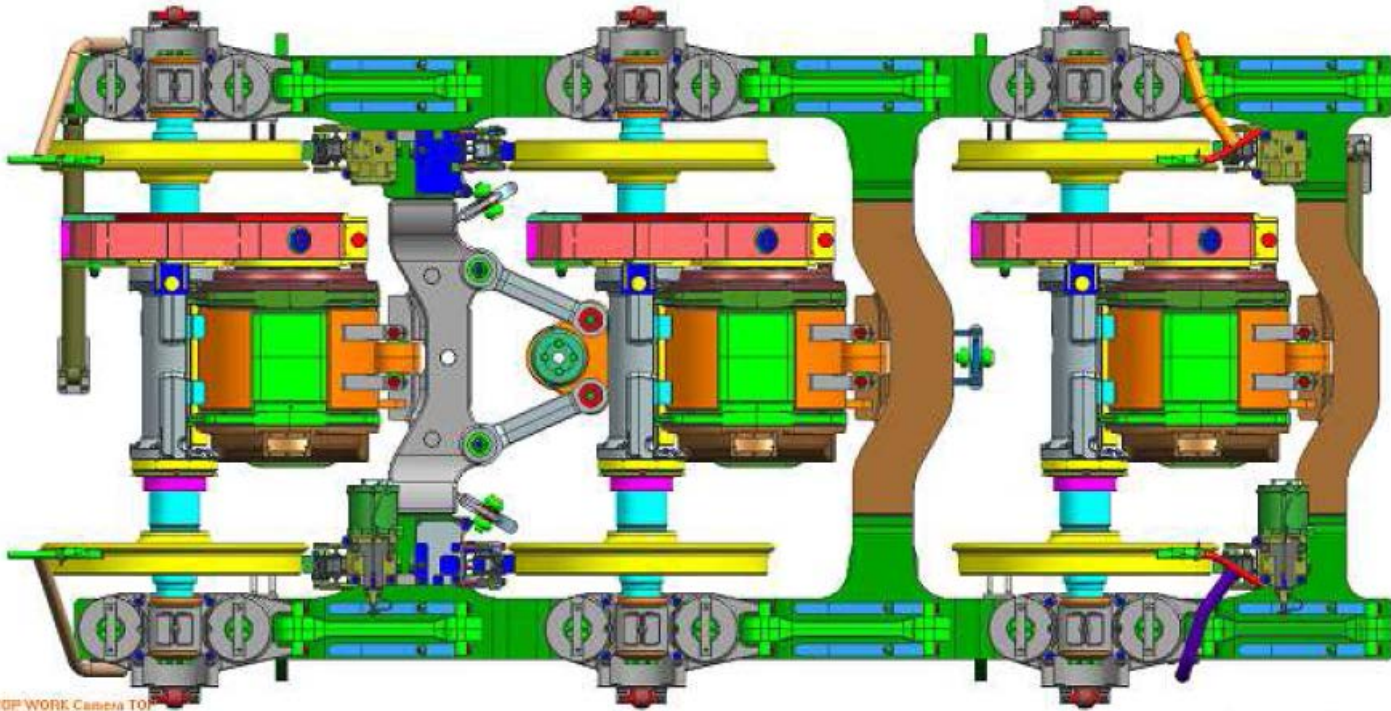


- The units on the middle axle of each bogie are flexible type
- Integrated slack adjuster to compensate for whole brake shoe and wheel wear.
- Integrated spring applied and air released parking brake
- There are six brake units per locomotive, two of which are equipped with the spring actuated parking brake, and are provided on the same side of end axles of each bogie.

38 | Tread Brake Unit – Main characteristics



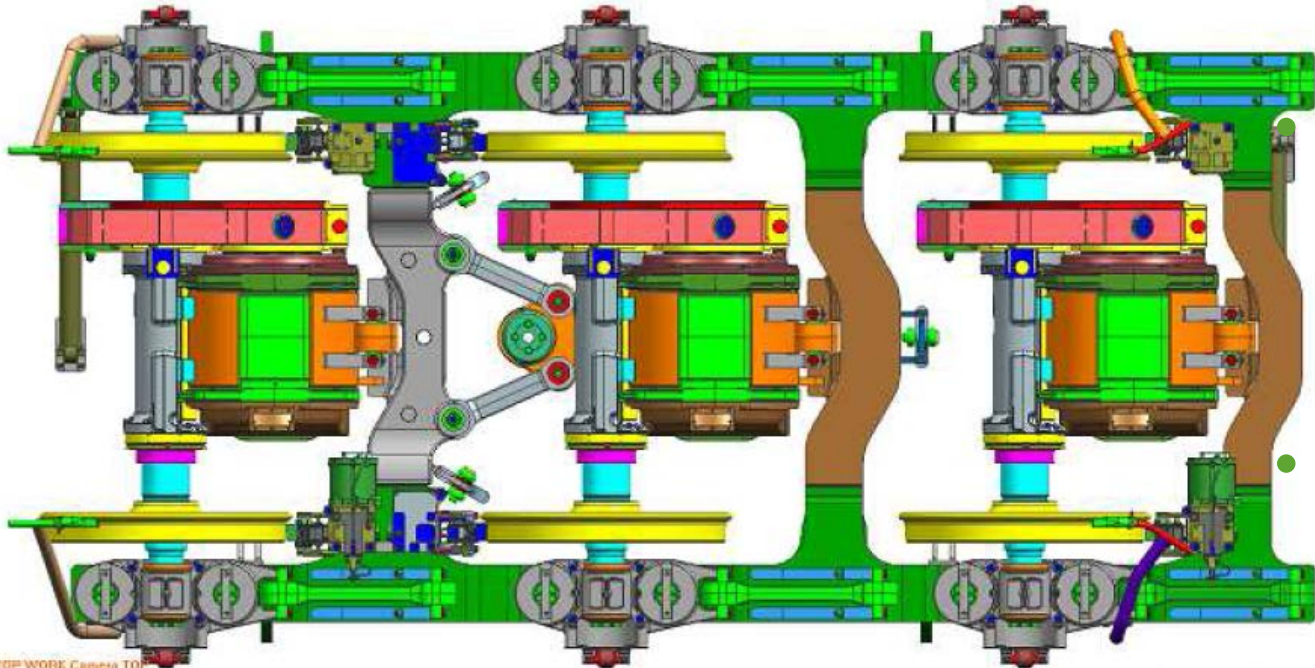
- Brake block units designed for use as service brakes contain the following assemblies:
 - Brake cylinder and piston.
 - Adjuster mechanism providing automatic adjustment in response to brake block and wheel tread wear.
 - Single acting slack adjuster which, after one brake application, automatically corrects the increasing clearance due to wear.
 - Reset mechanism for resetting the spindle after brake block replacement.
 - All units are mounted behind the axle.
 - Parking brake units are at non-gear side of the end axles.



39 Tread Brake Unit – Main characteristics



- Brake units for use as service and parking brakes are equipped additionally with a spring actuator.
- When the spring parking brake is applied, the force of the actuator springs acts on the piston in the block brake unit's brake cylinder through the cone coupling, nut and the spindle.



The spring actuator is equipped with a manual emergency release allowing the parking brakes of parked vehicles to be released without compressed air.

- To release the brakes, the operator must pull out the tappet by hand.

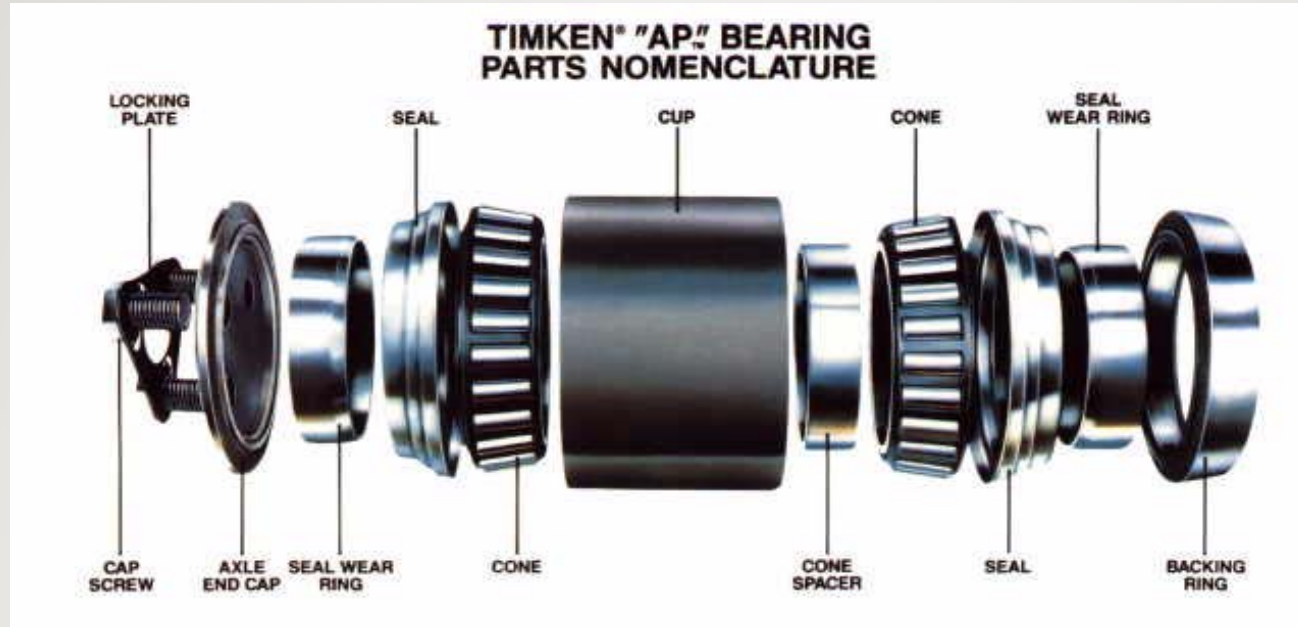
40 Weight comparison of WDG5 & WDG4 Bogies (excluding wheel Axle combos)

Sl. No.	Description of item	WDG5 Weight in Kgs	WDG4 Weight in Kgs	
1	Bogie Frame	3700	5000	
2	Bearing adapters, primary suspension & Traction rods	2000	1825	
3	Secondary suspension	450	400	
4	Brake system	400	700	
5	Nose link & Air ducts	200	250	
6	Car body linkage	200	160	
7	Misc. item	200	280	
	Total	7150	9215	

Wheel / motor changing

- DROP PIT ARRANGEMENT is recommended for EMD locomotives as conventional lifting jacks (JAMALPUR or WHITING jacks) require a lot of components to be removed before lifting the loco on jacks.
- Use of DROP PIT also facilitates uncoupling of any one bogie or changing any one wheel / motor at a time.
- DROP PIT should ideally be used in every EMD loco shed to reduce the down time in case of individual motor / wheel set changing.

42 Main parts of bearing



Details of axle bearing

- TIMKEN make AP-2 class K (6 ½ X 9) bearing (Model no. E-49181 and Part no. NP633994 90019).
- Each cartridge bearing is
 - Self-contained,
 - Pre-assembled,
 - Pre- adjusted,
 - Pre-lubricated and completely sealed,
 - Not requiring any field lubrication (**No - Field - Lubrication**) or maintenance during the lifetime of the wheel.
- The bearings are applied and/or removed without exposing the bearing elements, seats, or lubricant to contamination or damage.
- The bearing assembly is pressed on the axle as a completely sealed unit.
- It is retained on the axle by one end cap which in turn, is secured to the axle by three cap screws and a locking plate.

Visual inspection of roller brg

- Sign of overheating.
- Excessive lubricant leakage.
- Broken, loose or missing parts (i.e. loose cap screw etc)
- Loose or defective seals.
- Cracked or broken cups, end caps, adopter etc.
- Normal temp 56°C above ambient
- Not allowed above 93°C .

45 | Current problems

- Excessive consumption of gear case oil.
- Frequent breakage of vertical damper top brackets.
- Excessive lurching during run.
- Failure of AC Traction motors.
- Cracks in fabricated bogie frames.



Enroute out of course attention

- As per instructions contained in RDSO's instruction bulletin No. MP-IB-VL-03-14-10 (Rev.00) circulated vide L/No. SV.IB dt. 25.03.10
- Wheel set trolley as per Drg No. SK.VL 215 to 218.
- Maximum permissible speed for a wheel lifted locomotive is 20 kmph on straight track and 15 kmph on curves.
- Movement in night is not recommended.

47 Towing equipment



Old Design



New Compact Design