

BALANCED DRAFT GEAR

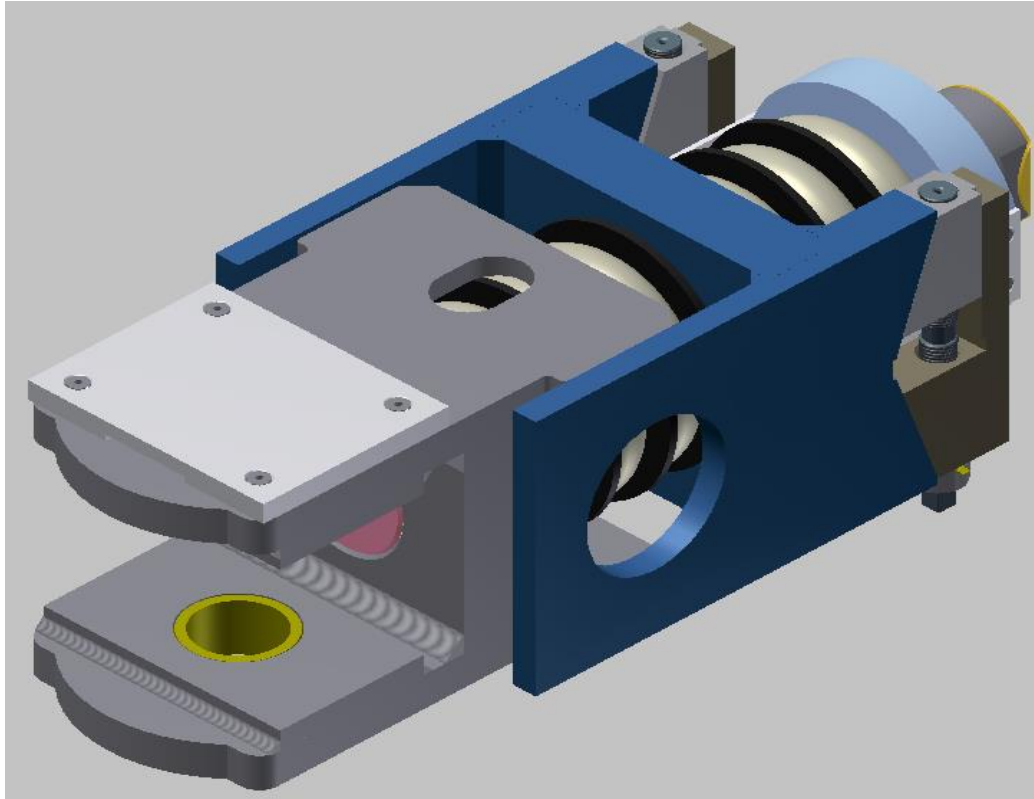
Presented By

Rajendra Kushwaha

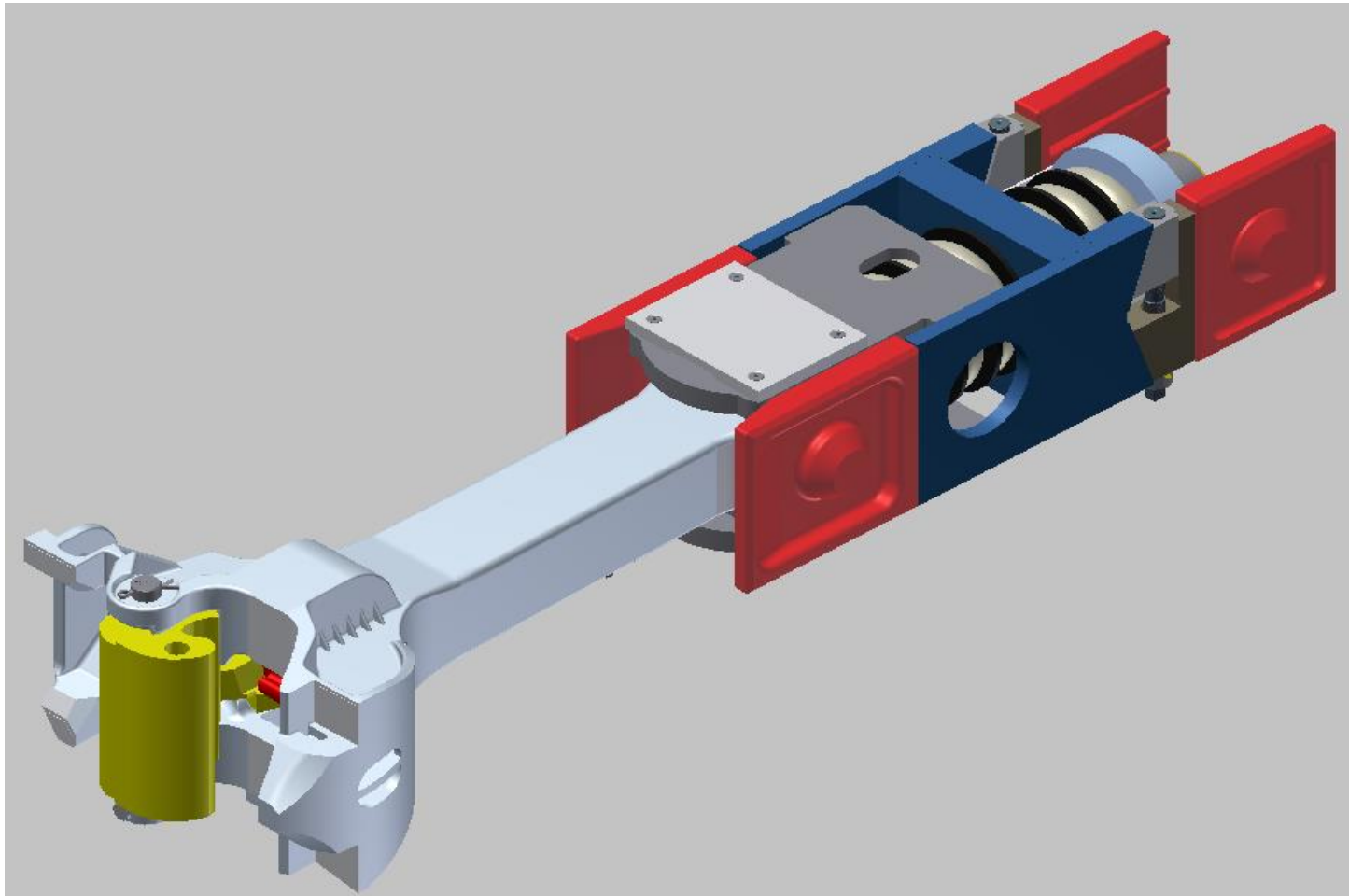
Inst./C&W

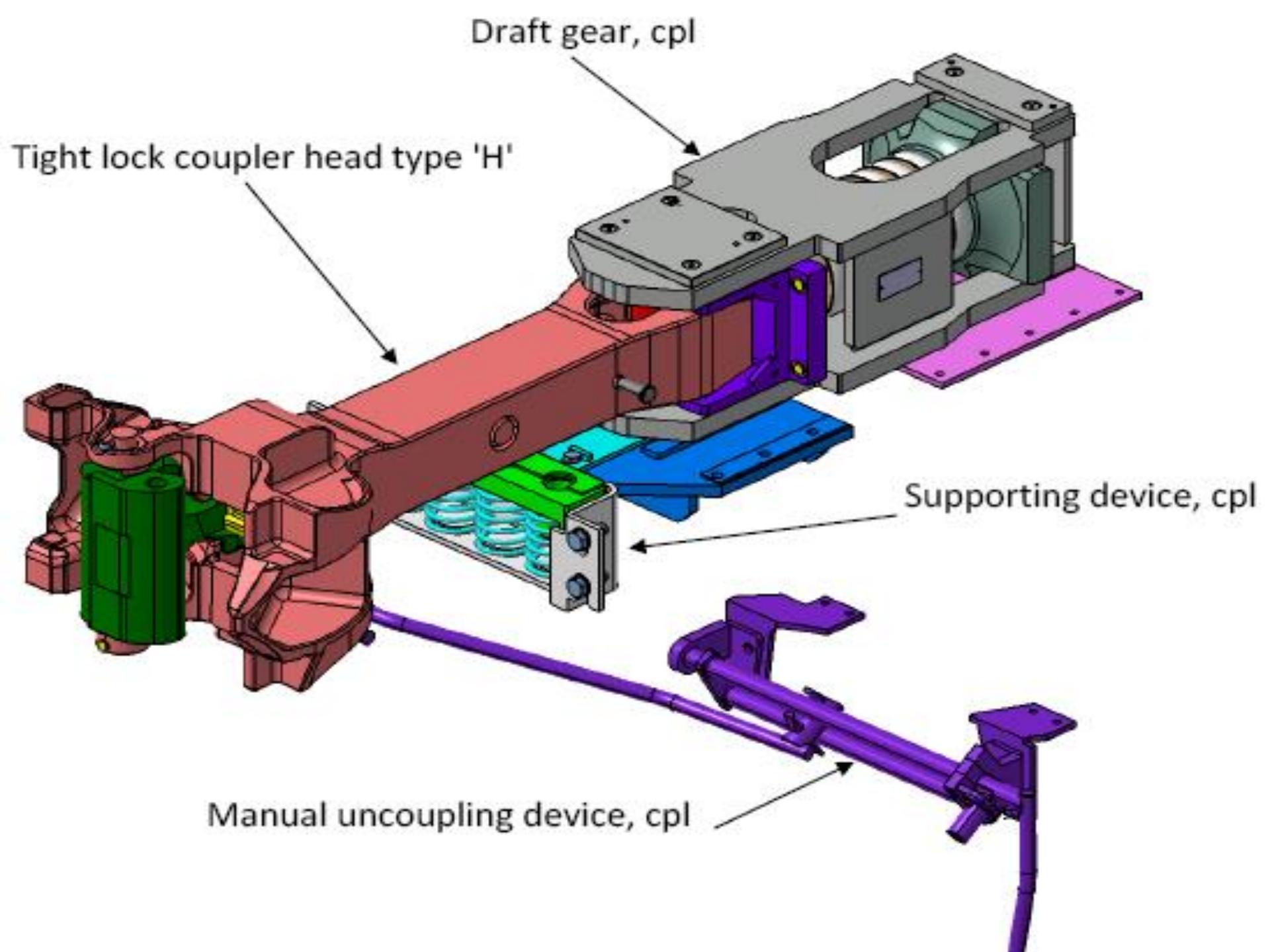
MSTC /NER/GKP

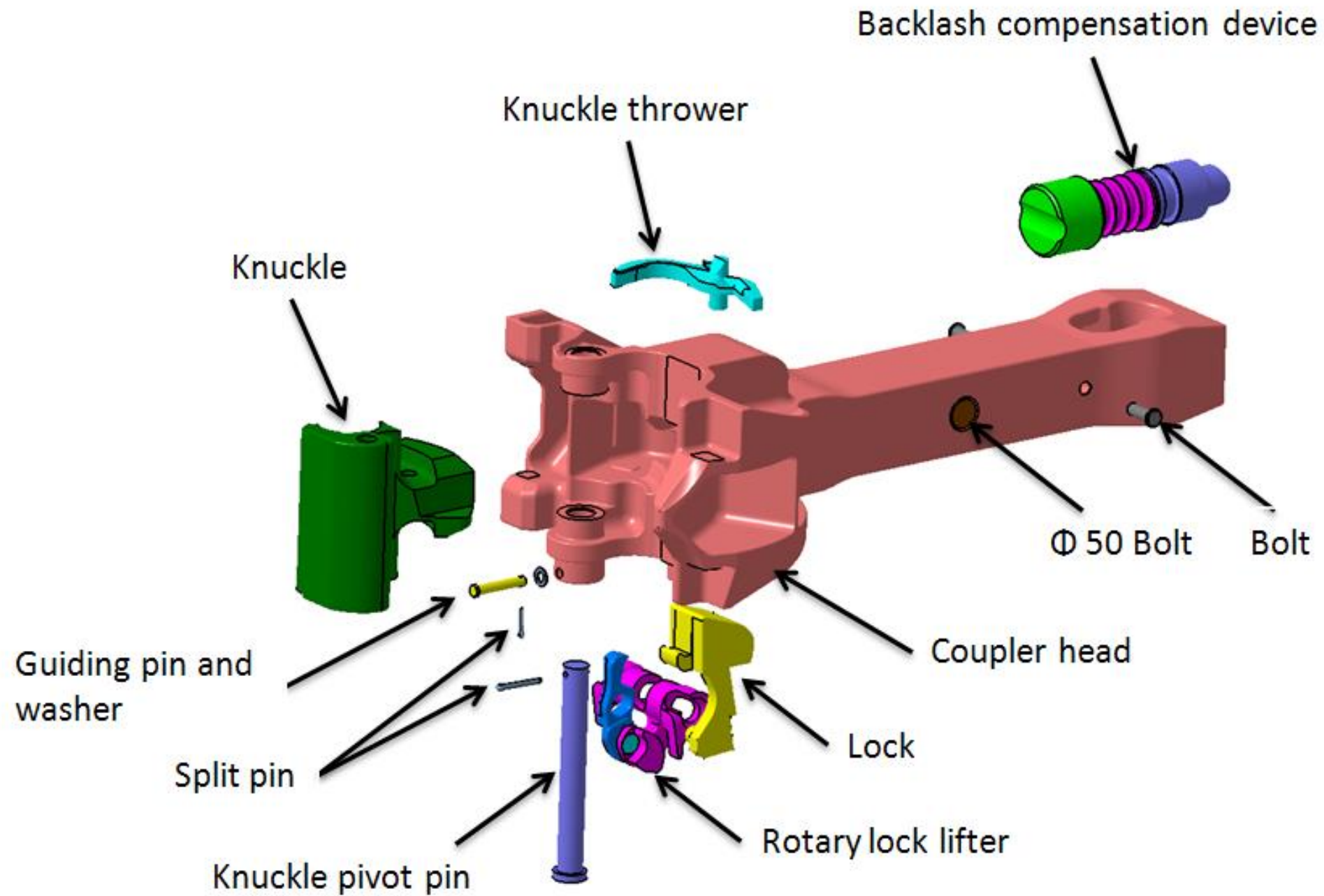
BALANCED DRAFT GEAR



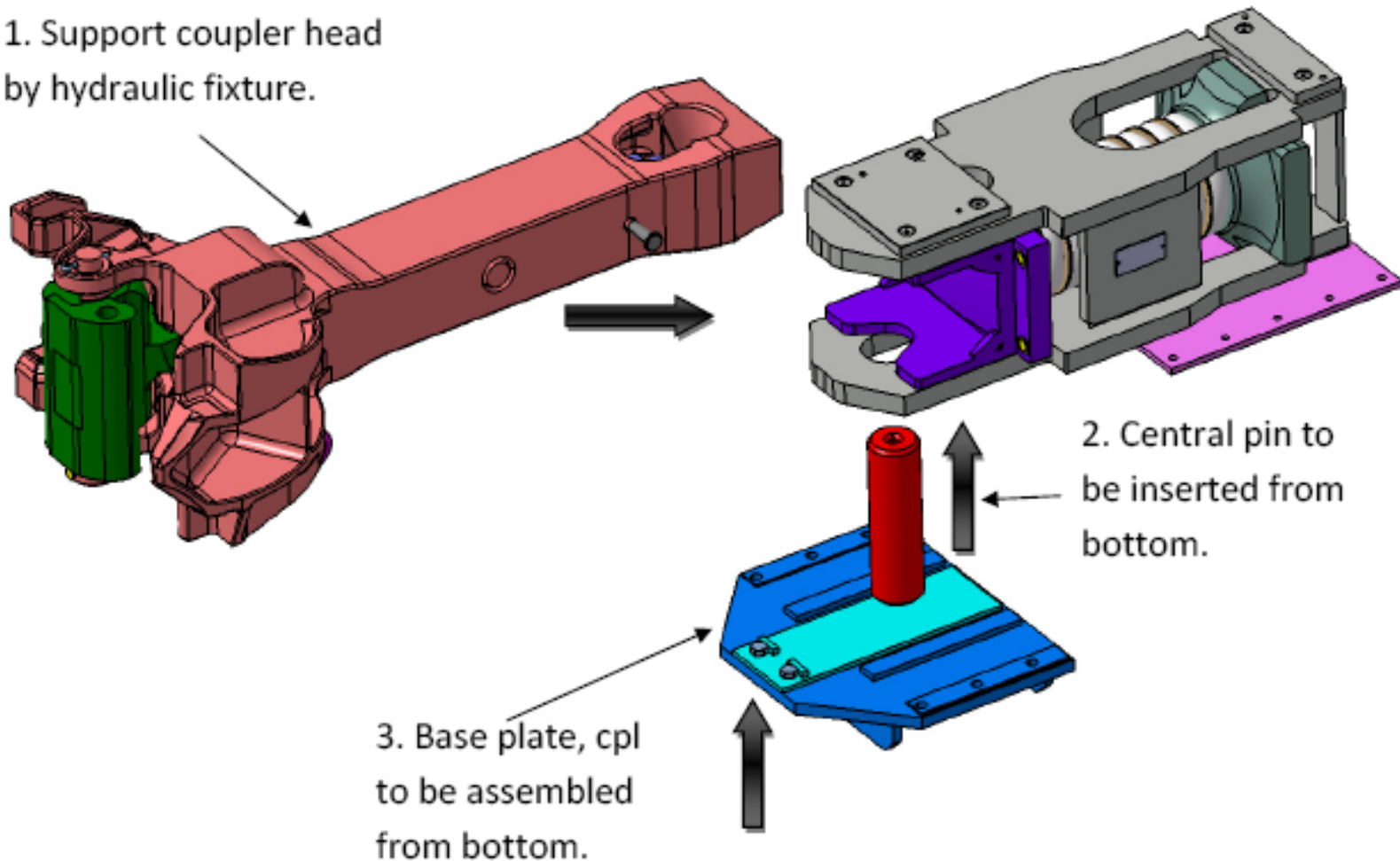
AAR H coupler with BDG







1. Support coupler head
by hydraulic fixture.



Mounting of the Coupler head

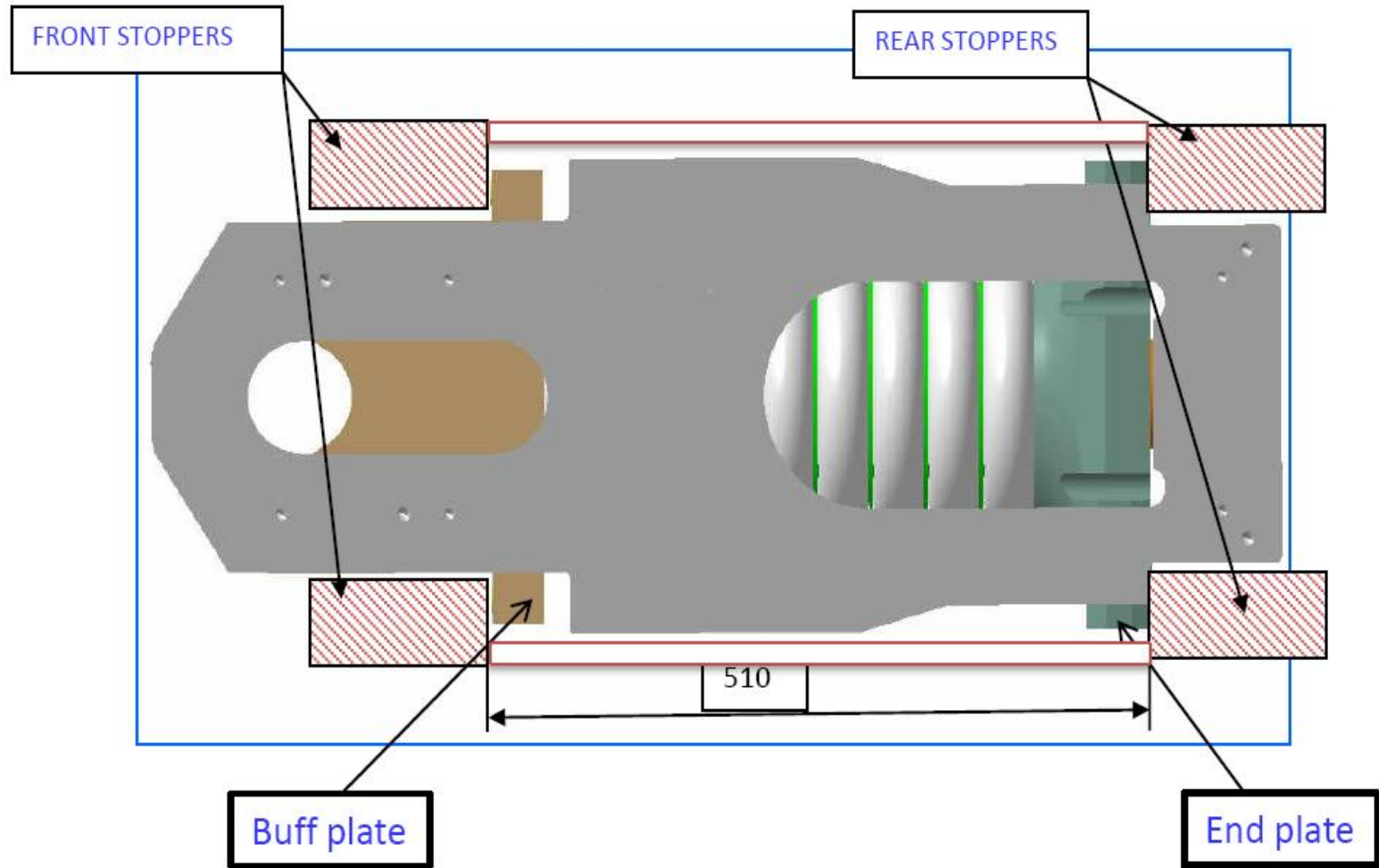
- IR introduced High Tensile AAR 'H' type Tight Lock Centre Buffer Coupler on passenger coaches with the view to have longer train rakes, higher speed and safety features.
- AAR 'H' type Centre Buffer Coupler (CBC) was first time used in 24 imported Alstom /LHB coaches.
- The trains fitted with these couplers, when put in service, "Jerks" were observed.
- The AAR H coupler has been supplied by FTIL and Escorts which are fitted std Draft Gear, all were observed to have Jerks.

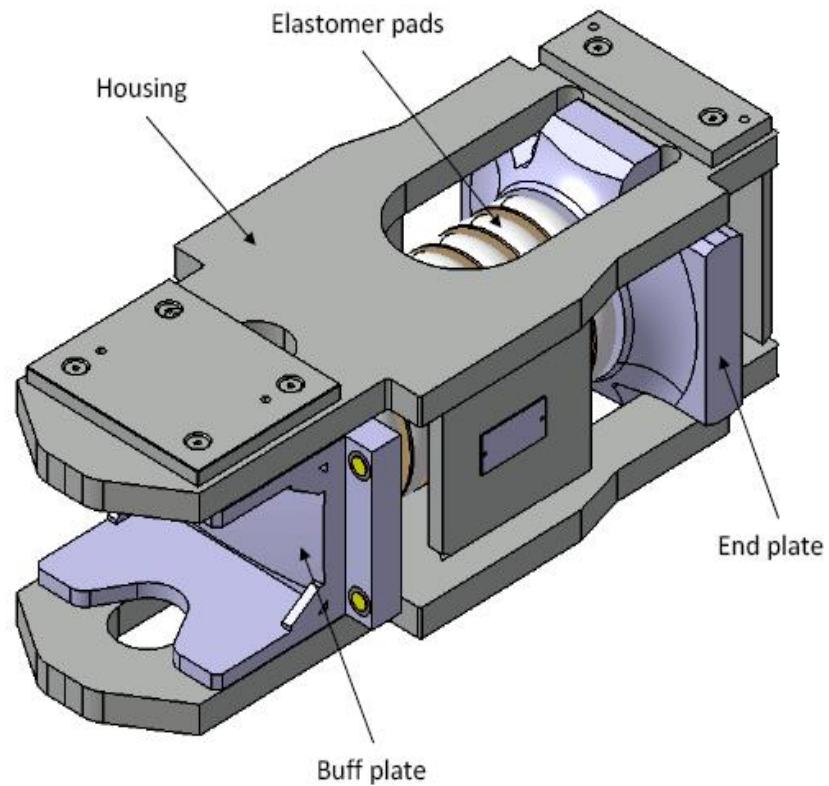
- Longitudinal jerks in mainline coaches equipped with CBC have been a major concern since introduction of CBC.
- Several measures were taken in the past to reduce the longitudinal jerks but they resulted in minor improvements only.

- The specification of CBC CK-009 (Rev.2) does not specify the type of draft gear. Suppliers are free to supply any type of draft gear such as single pack, twin pack, floating plate or any other design-
- On the basis of a systematic study of design of CBC, a new specification of CBC has been made.
- In the new specification, **balanced type draft gear** has been specified.

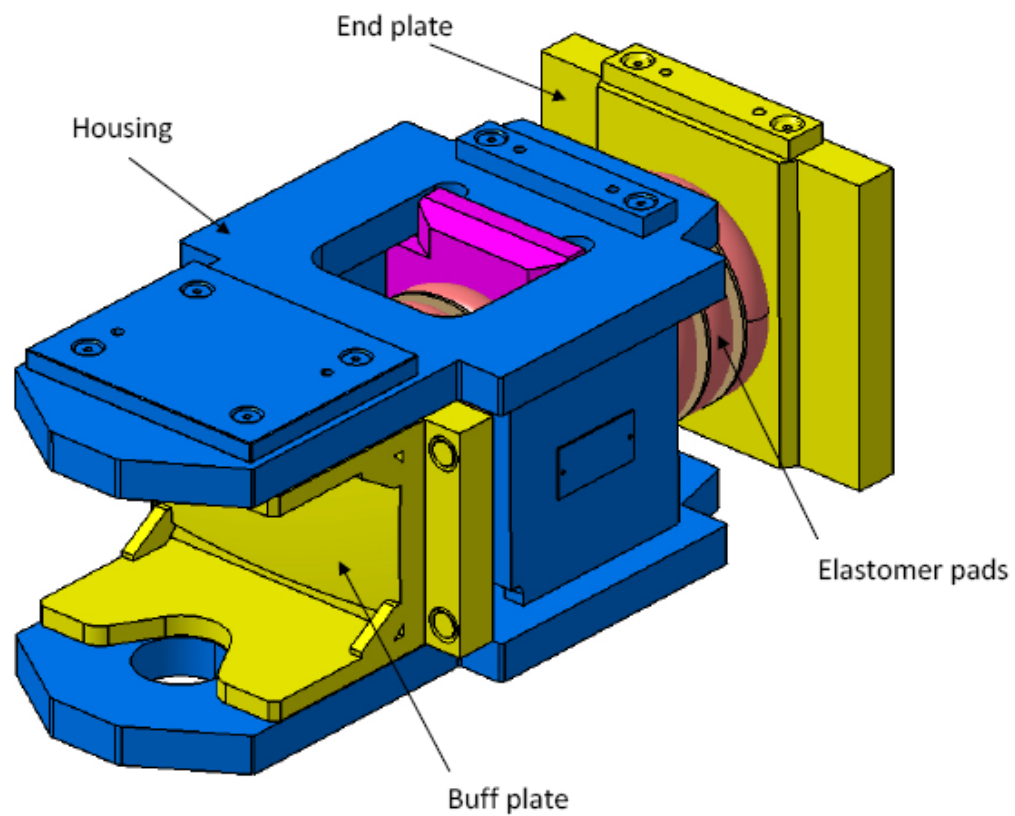
The couplers to this new specification have been mostly supplied to IR by M/s Faiveley, M/s ASF-Keystone and M/s Escorts.

Type of draft gear	Population (Coach sets)	Service Since
Single pack	2560	Year 2001
Twin pack	325	Year 2004
Floating Plate	30	February 2010
Balanced type	22	February 2011





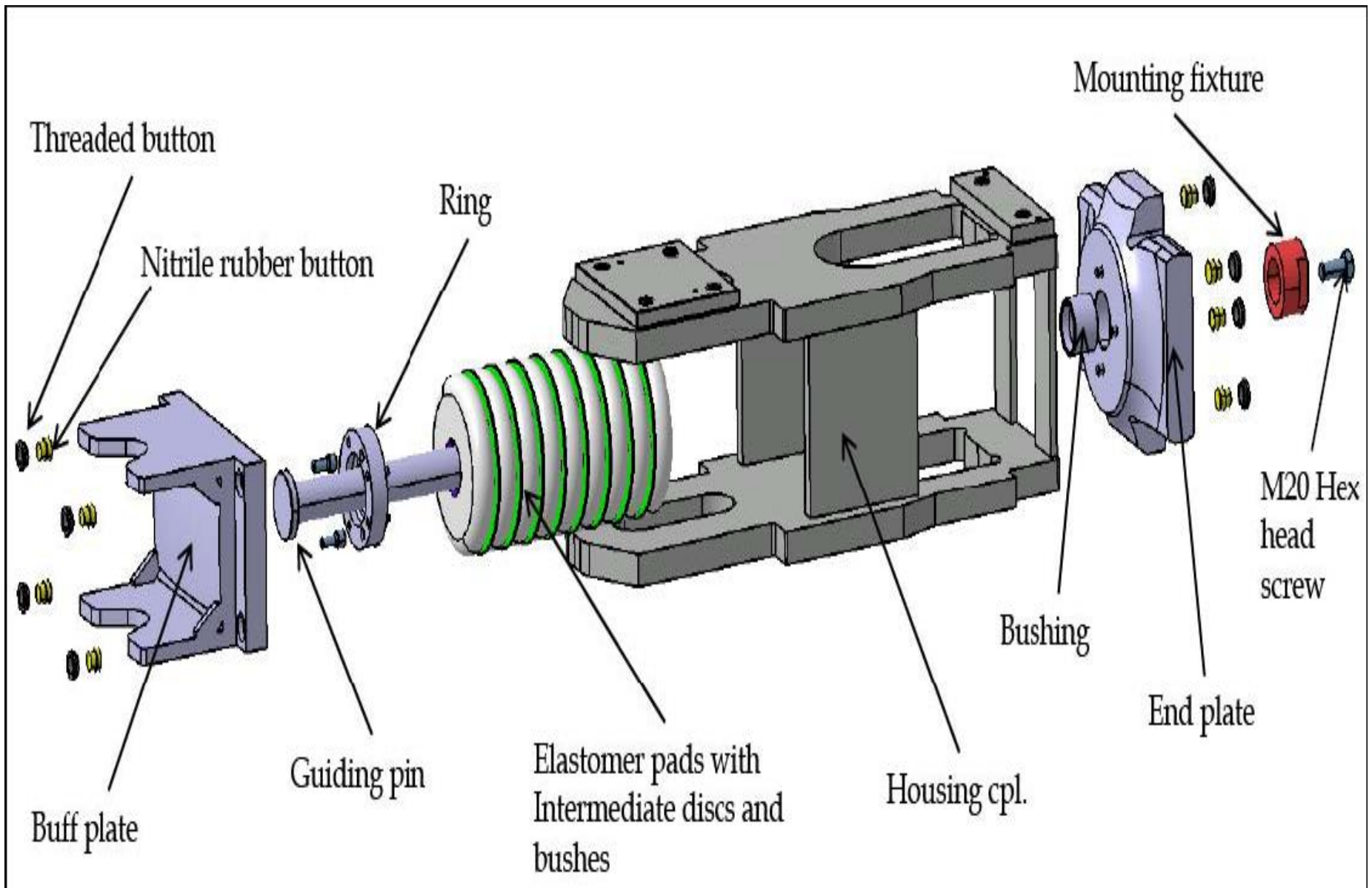
Draft gear, cpl



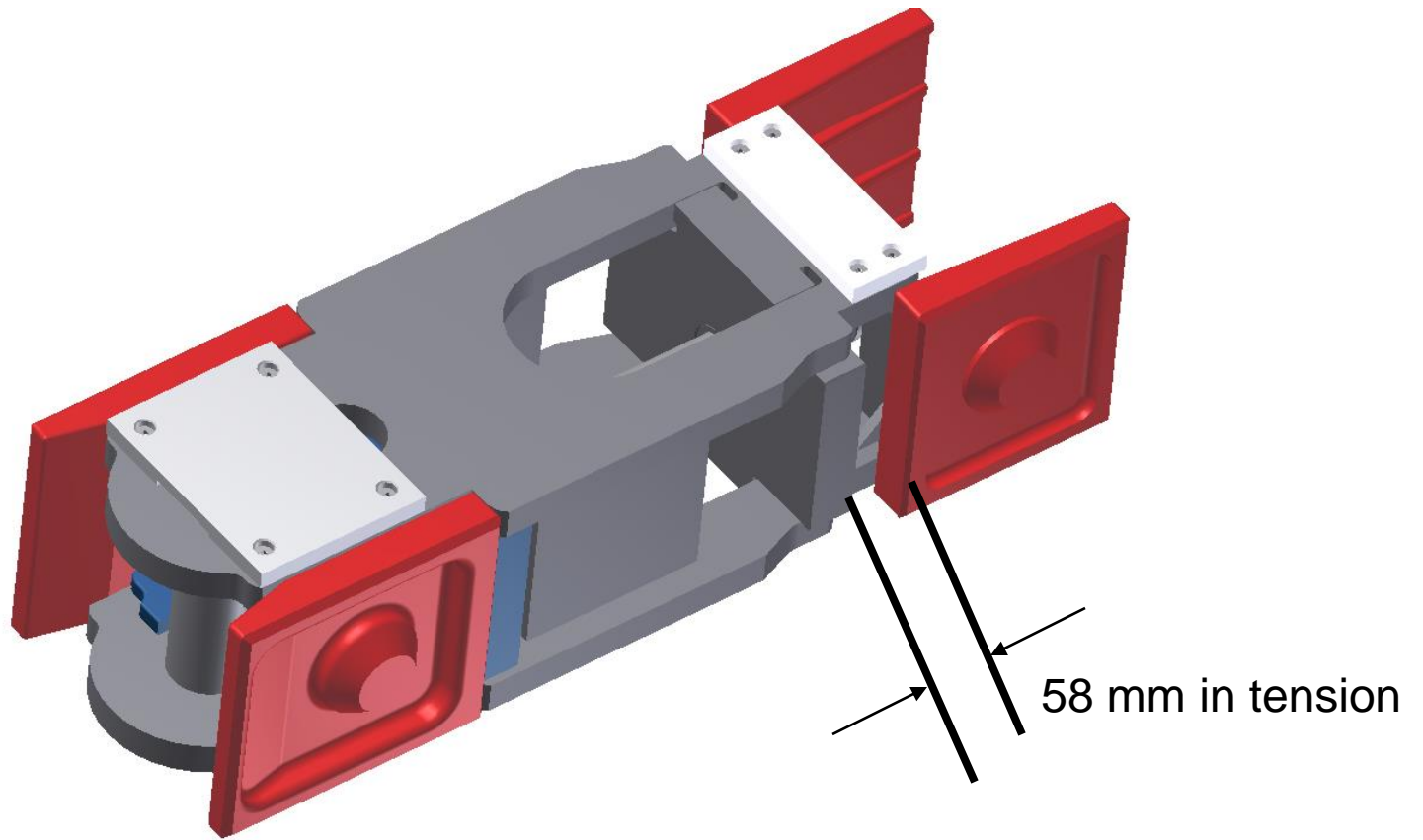
Draft Gear, cpl. with Floating
plate, Type BC 80/45F

• Single Pack Draft Gear

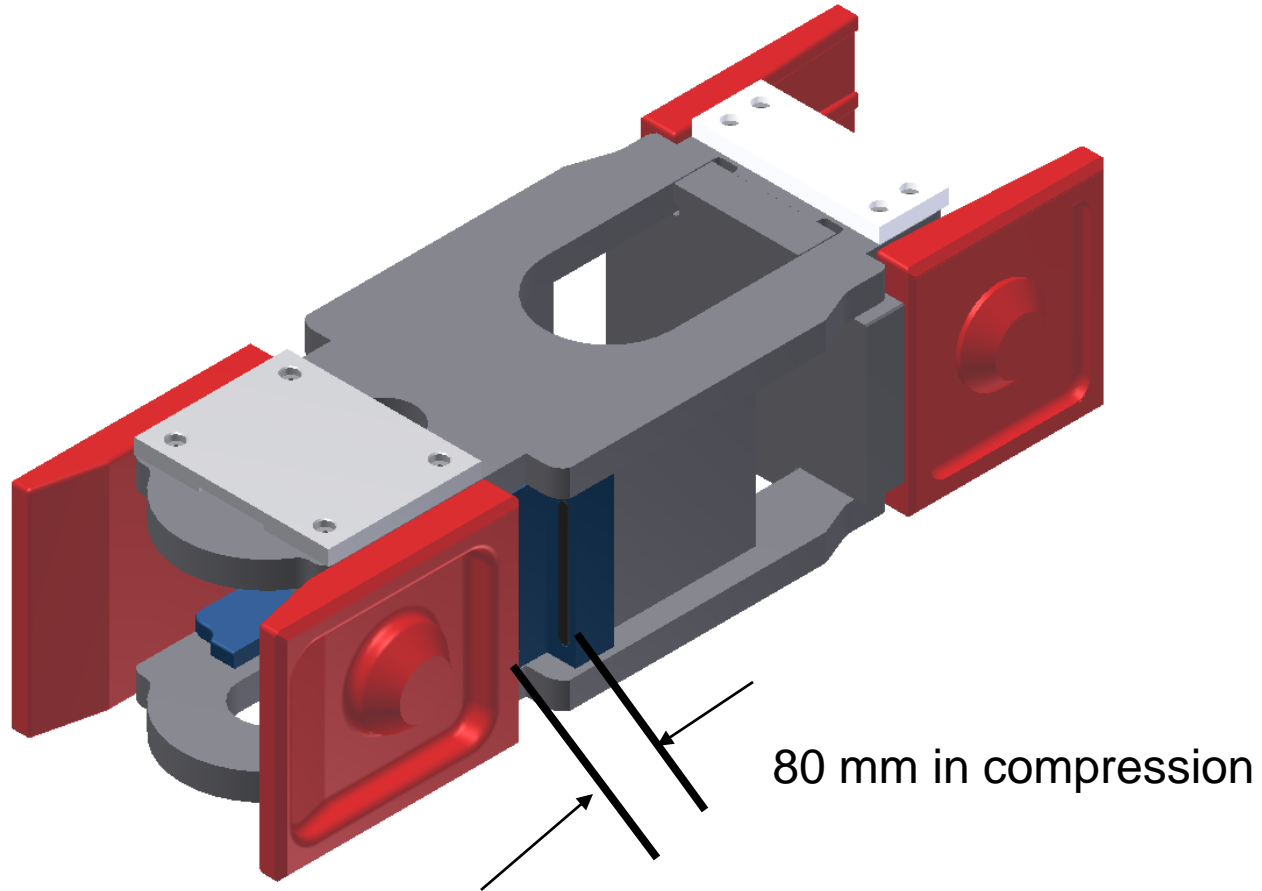
- In this type of draft gear, same set of draft pads is used in buff as well as in draw mode.
- In dynamic condition, the front follower leaves the front stopper during buff and the rear followers leaves the rear stopper during draw modes and hits them on load reversal.

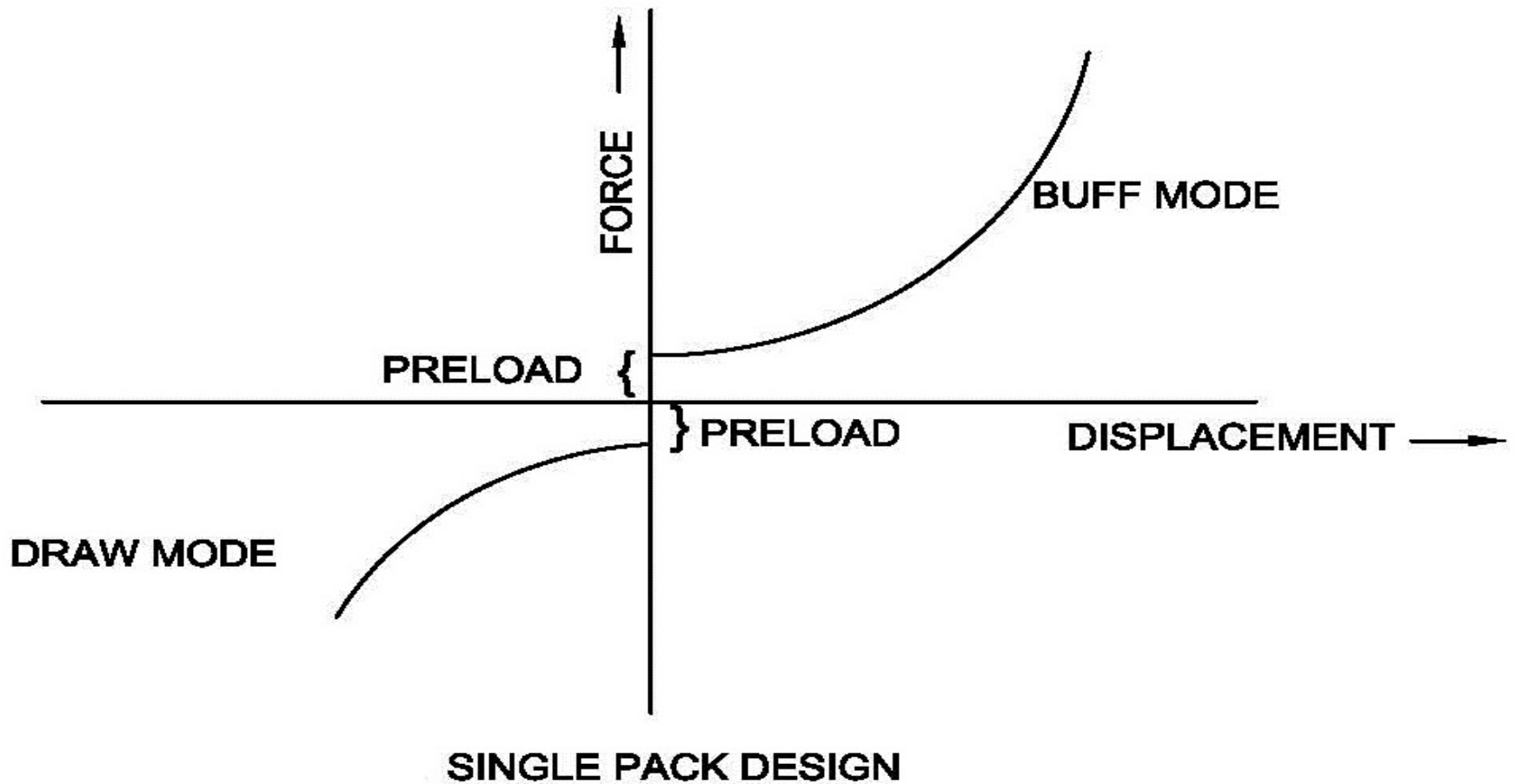


STANDARD DRAFT GEAR IN TENSILE MODE



STANDARD DRAFT GEAR IN COMPRESSION MODE



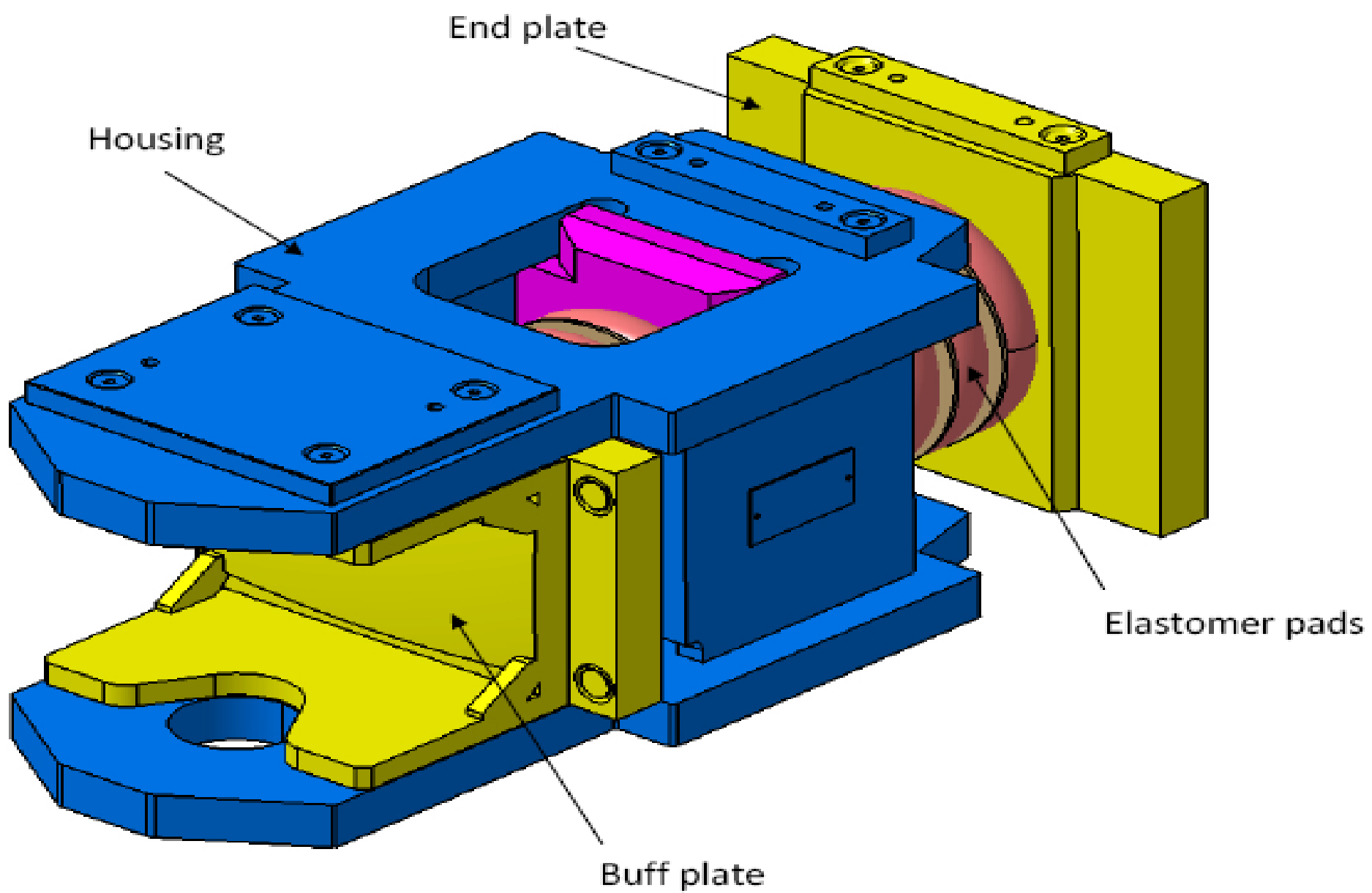


Travel Characteristics of Single Pack Draft Gear

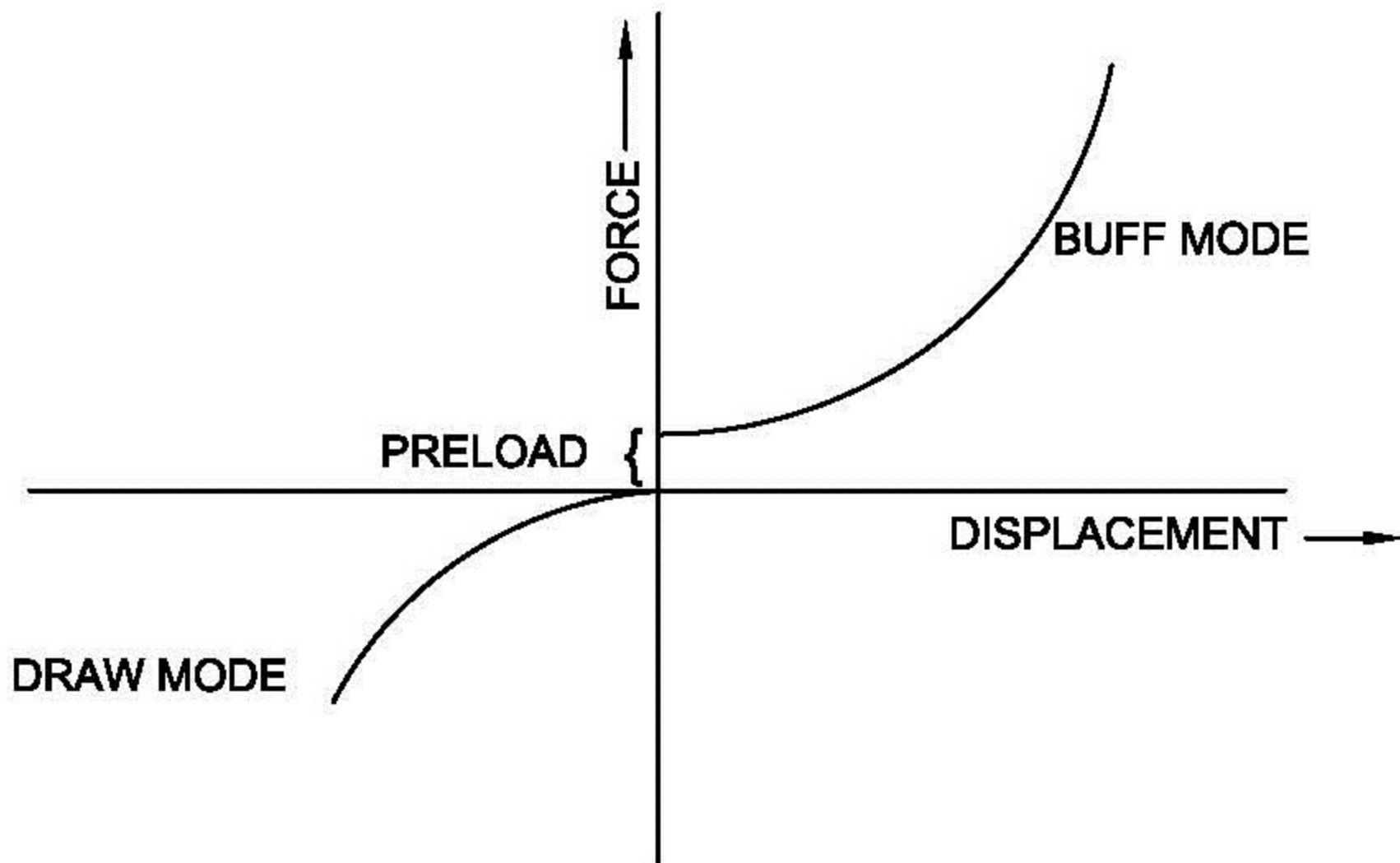
Floating Plate or Twin Pack Draft Gear

- Floating plate or twin pack draft gear has similar cushioning arrangement.
- In floating plate or twin pack draft gear, the problem of rear follower plate striking the rear stopper has been addressed by dividing the draft pads into two parts
- by a floating plate and using this floating plate for the purpose of transmitting force in draw mode.
- In draw mode, only draft pads between floating plates and front follower is compressed where as in buff mode, all the draft pads are used to take buff load.
- It has zero preload in draw mode.

- However, in buff mode, this type of draft gear behaves in a way similar to single pack draft gear.
- In dynamic condition, the front follower leaves the front stopper and hits it on load reversal.
- Also, preload in the buff mode adversely affects the longitudinal dynamics of a train.



Draft Gear, cpl. with Floating
plate, Type BC 80/45F

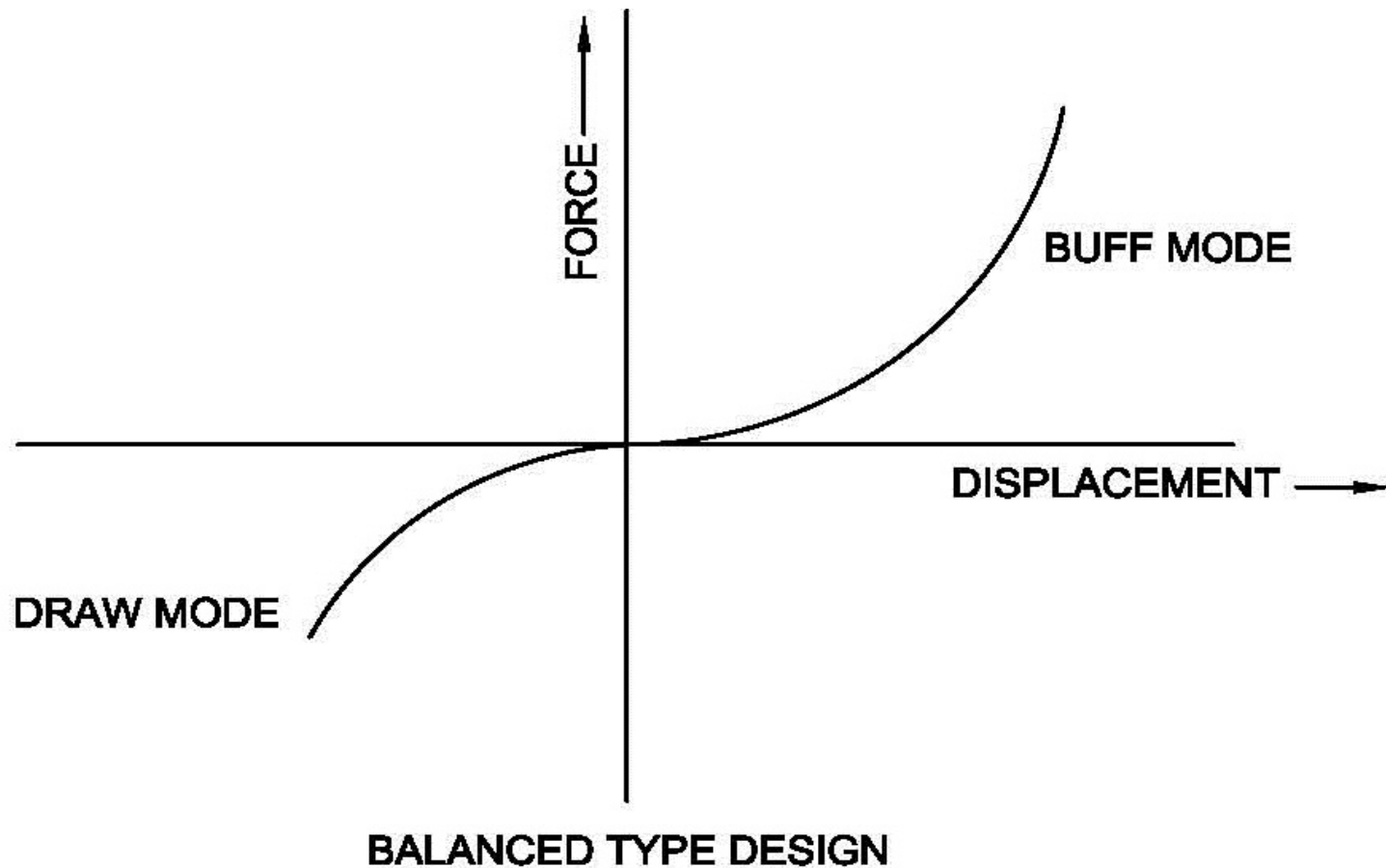


TWIN PACK AND FLOATING PLATE TYPE DESIGN

Balanced Type Draft Gear

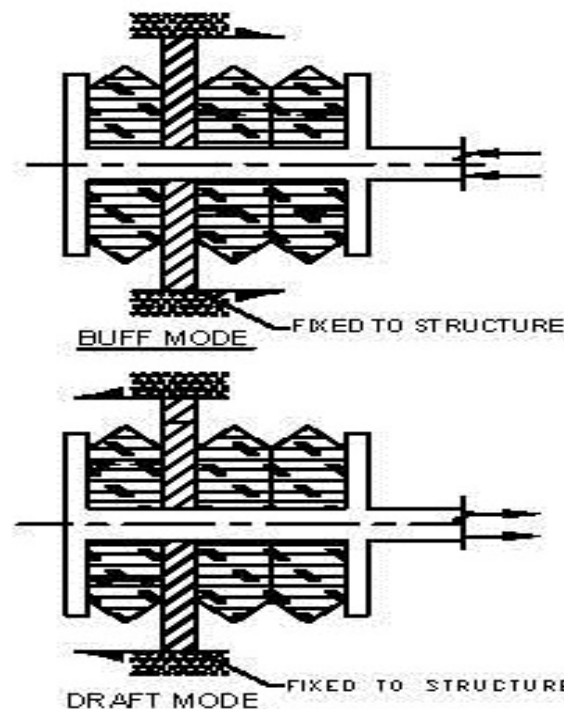
- Balanced type draft gear overcomes all the problems mentioned in the above sections.
- The draft gear is fixed between the front and rear stopper and no relative movement between the draft gear frames and these stoppers is possible.
- There is no situation of front follower leaving the front stopper and rear follower leaving the rear stopper and hitting them on load reversal.

- Apart from this, the following diagram of conceptual draft gear characteristics.
- shows that there is no abrupt change in force on load reversal.
- Force travel curves are regular and they are not vertically separated at neutral position.
- It facilitates smooth load reversal.



Travel Characteristics of Balanced Type Draft Gear

FORCE FLOW DIAGRAM OF DOUBLE
ACTING BALANCED DRAFT GEAR

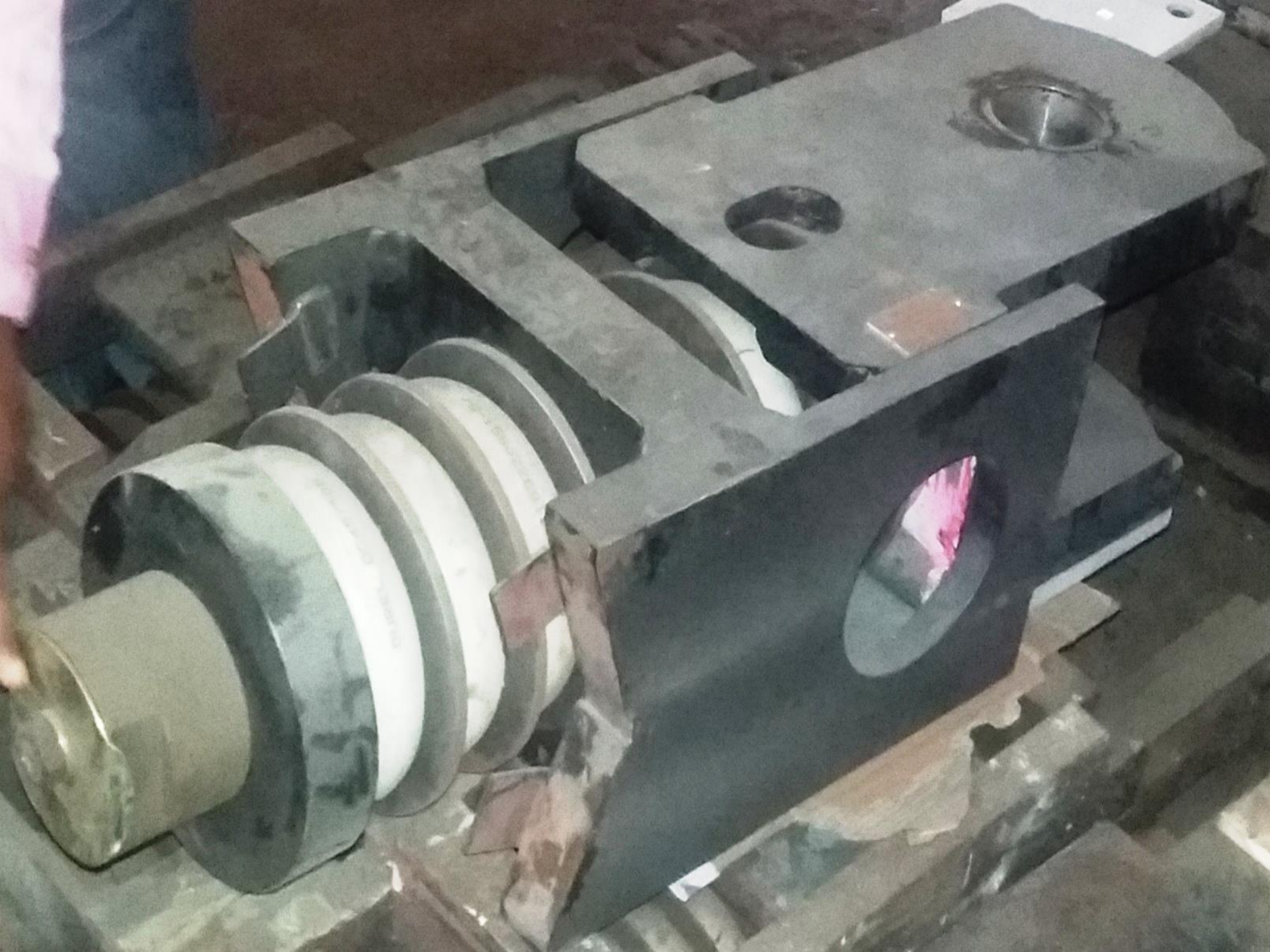


NOTE

1. NO. OF PAD SHOWN IN THE SKETCH IS SYMBOLIC ONLY.
2. DRAFT GEAR ARRANGEMENT SHALL HAVE EFFECTIVE ZERO PRELOAD IN BUFF AS WELL AS DRAFT MODE. IT MEANS THAT FORCE VS DISPLACEMENT CURVE OF DRAFT GEAR CHARACTERISTICS DRAWN FOR QUASISTATIC CONDITION SHALL PASS THROUGH ZERO FORCE AND SHALL HAVE REGULAR CURVE (NOT SEPARATED BY VERTICAL LINE) IN LOAD REVERSAL IN BOTH THE DIRECTIONS i.e.
(a) BUFF TO NEUTRAL TO DRAW AND
(b) DRAW TO NEUTRAL TO BUFF.

REFERENCE:-	1	CB/48/11	NOTE ADDED.		08/11
	ALT.	AUTHY	DESCRIPTION		DATE
	SUPERSEDED BY				
	SUPERSEDES		AUT. NIL		
SCALE	F		FORCE FLOW DIAGRAM OF DOUBLE ACTING BALANCED DRAFT GEAR		
	C				
	D	SP/Avazh.			
	T				
	JS	CB/10/08			
FILE No.:-	BG	RDSO (CARRIAGE)		CG- K8207	

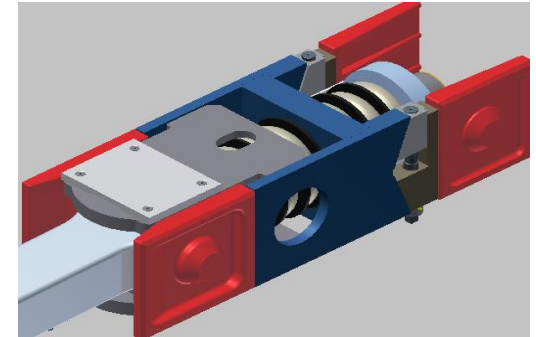
- No. Of pad shown in the sketch is symbolic only.
- Draft gear arrangement shall have effective zero preload in buff as well as draft mode.
- It means that force vs displacement curve of draft gear characteristics drawn for quasistatic condition shall pass through zero force and shall have regular curve (not separated by vertical line) in load reversal in both the direction i.e.
 - (a) buff to neutral to draw &
 - (b) draw to neutral to buff.





BDG MAJOR COMPONENTS

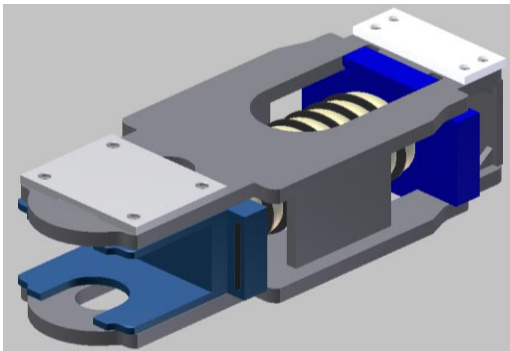
- **Stack of Heavy Duty Elastomeric Pads (Imported) - 04 in compression & 03 in tensile mode.**
- **PA-6 bushes for smooth sliding of intermediate plates & pads over Main bolt.**
- **Fabricated Front Fork & H - Housing.**
- **Main bolt - High toughness, forged.**
- **Adjustable wedges to tighten the BDG assembly with coach under frame.**
- **The fixed plate, a part of H Housing (blue color,) which is tight fitted with coach under frame (red color) between front & rear stoppers with the help of special design wedge key.**



COMPARISON

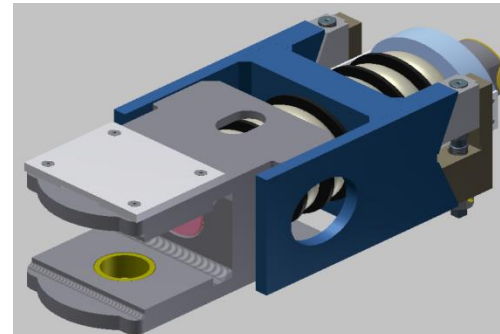
CONVENTIONAL DRAFT GEAR

- Energy absorption 45 KJ in dynamic testing as per RDSO specification CK 009(Rev.02)
- Single pack of 10 Nos. Elastomeric pads used in buff & tensile loading.
- Life is average due to single pack takes load in both buff & tensile mode.
- Jerks experienced in longitudinal train dynamics.
- Escorts drawing No. DG-01-15(Rev.5) for Draft Gear.
- Draft Gear size (length $510+0/-5$ * width 345 * height 275 mm) is suitable to fit in coach under frame pocket



BALANCED DRAFT GEAR

- Energy absorption 45 KJ in dynamic testing as per RDSO specification CK 009(Rev.02).
- Two separate packs of Elastomeric pads (4 pads in Buff & 3 pads in tension) have been used.
- Enhanced fatigue life due to separate packs used for buff & tensile loading.
- Jerks totally eliminated in longitudinal train dynamics by enhancing design.
- Escorts Drawing No. SK 1550(Rev.8) for Balanced Draft Gear.
- Draft Gear size (length $510+0/-5$ * width 345 * height 275 mm) is suitable to fit in coach under frame pocket

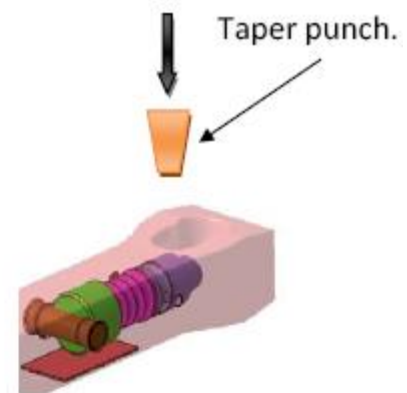
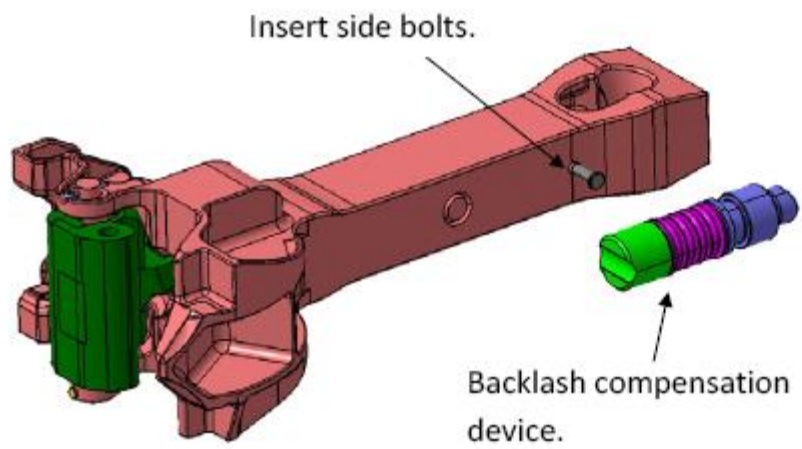


Following are the subjective assessment of relative performance of various types of draft gear

Performance Criteria#	Single Pack Draft Gear	Twin Pack Draft Gear	Balanced Draft Gear
Energy storage Capacity in Draw mode	*****	***	***
Energy storage Capacity in Buff Mode	*****	*****	***
Longitudinal Train Dynamics (Jerk Free)	*	**	*****

- Higher number of * means better attributes.

- Stabilizing link in case used with the balanced type of draft gear creates a reverse situation in which draft gear has effectively zero preload but stabilizing link has preload of 25 kN.
- The new specification specifies linking arrangement between coupler and draft gear to overcome this problem.
- Spherolastic bearing prescribed in the specification meets the functional requirement of articulation. Apart from its role of providing articulation to coupler head, it helps in blocking transmission of vibration and noise to coach body.





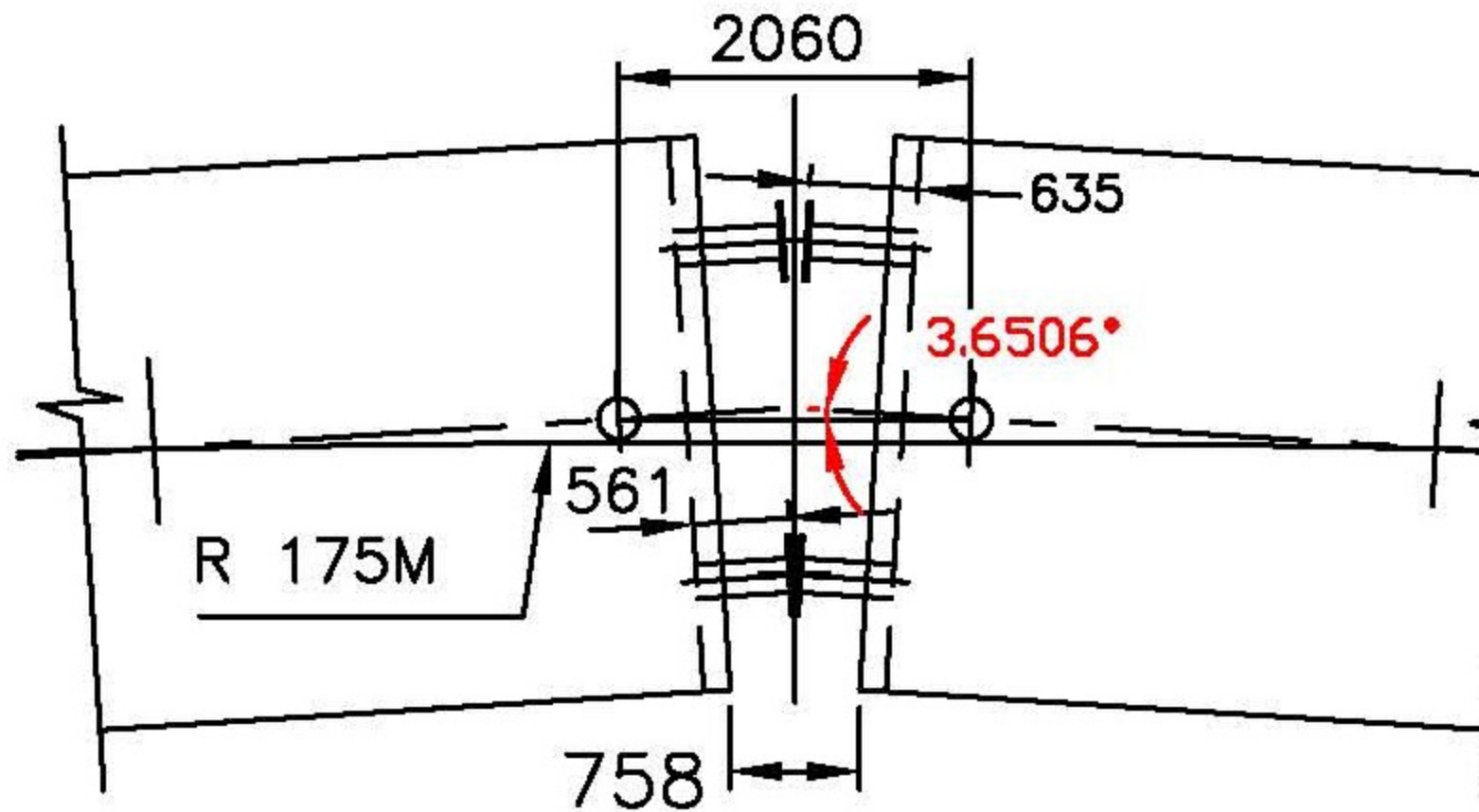






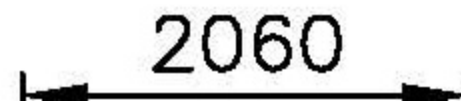


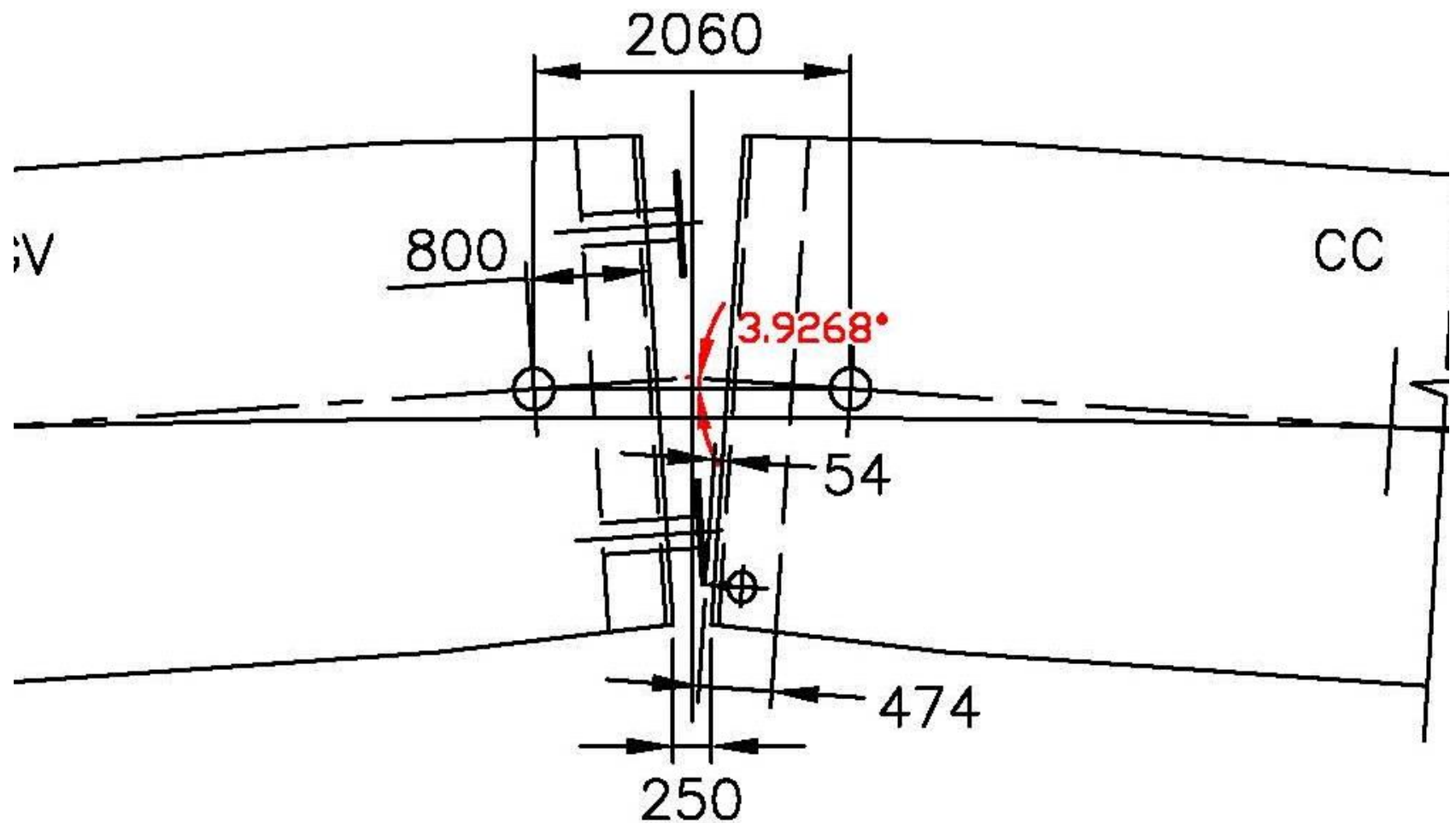
- Various doubts have been raised on using articulation inside draft gear.
- Analysis of LHB coach on 10 degree curve indicates that geometrical requirement of coupler head movement because of curvature of track is 3.9 degree horizontal swing.
- The estimated bending force because of this horizontal swing is insignificant as compared to bending strength of the shank prescribed in the specification.



CONDITION:— NO COMPRESSION IN BOTH THE DRAFT GEARS

ICF COACH COUPLED WITH ANOTHER ICF COACH

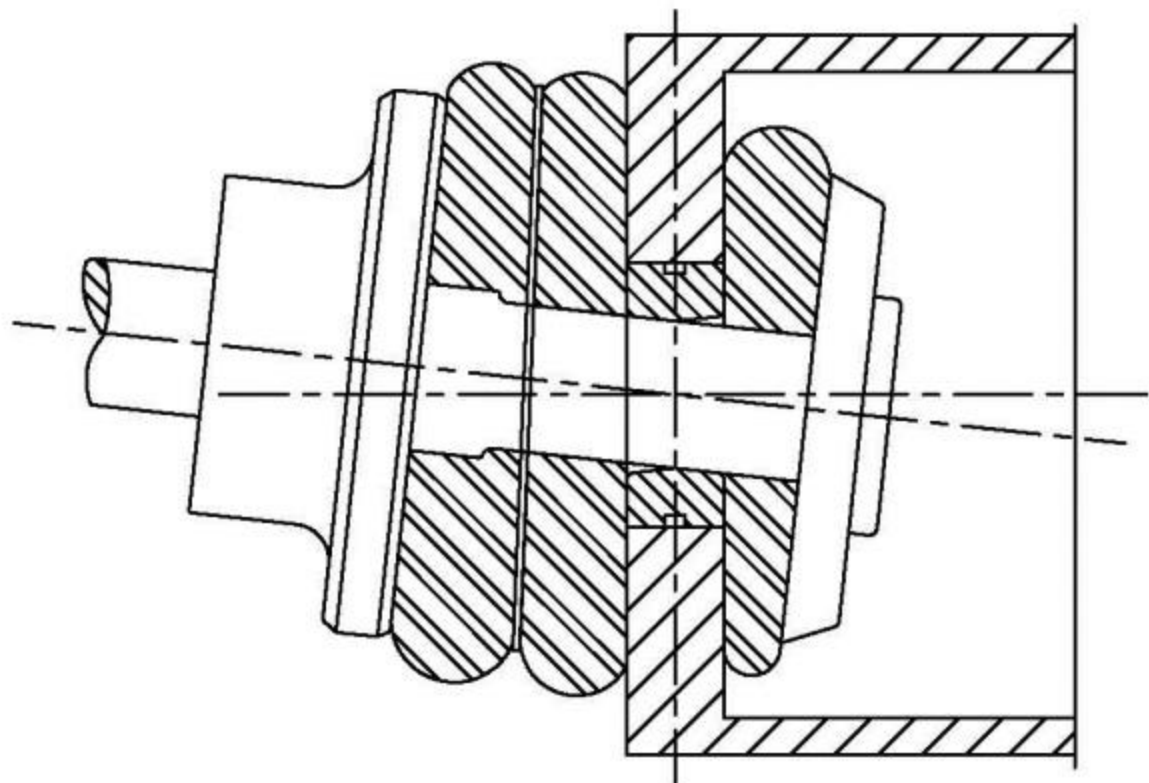




CONDITION:— NO COMPRESSION IN BOTH THE DRAFT GEARS

LHB COACH COUPLED WITH ANOTHER LHB COACH

- In many coupling system design, some stiffness and damping in horizontal swing is desirable to prevent **yaw** of a coach during the taking of curve, transitions and switch points.



BALANCED TYPE DRAFT GEAR WHILE NEGOTIATING CURVE

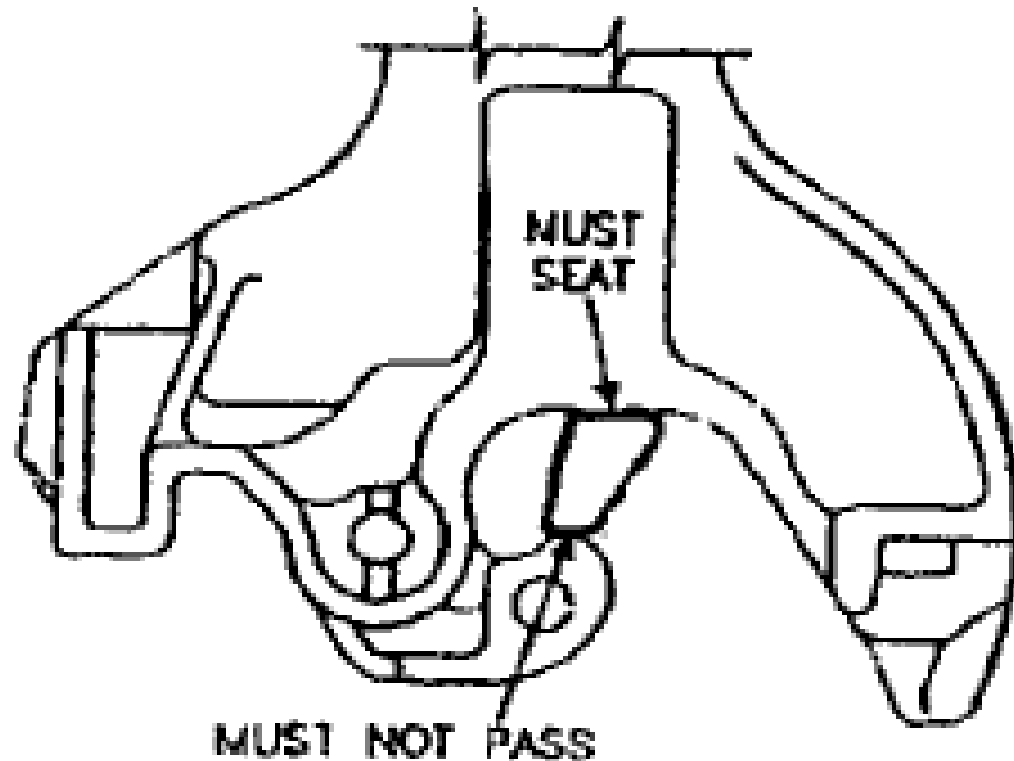
ADVANTAGES

- Design aims at eliminating Jerk.
- In new design Draft Gear (BDG), Jerk & hammer noise problem has been eliminated completely by modifying the design.
- On the other hand End force has been balanced in tensile as well as in compressive mode.
- Enhanced life of equipment by using Durel GmbH heavy duty Elastomeric pads.
- Balanced Draft Gear flexible connection with coupler shank is a proven one and eases the horizontal & vertical movement of coupler head.
- Poly Acetel bushes used to avoid wear of Main bolt from metallic separator plates.
- In BDG separate packs of heavy duty Elastomeric pads have been used for tension and compression which will enhance the life of equipment up to double of conventional Draft Gear.

BDG 04 pads stack is equal to 10 pads stack of conventional Draft Gear in Energy absorption and damping. BDG have bigger size imported (Durel Germany) pads than conventional Draft Gear pads.

Jaw gap test :

We check the contour of the coupler head assembly using “Condemning limit gauge



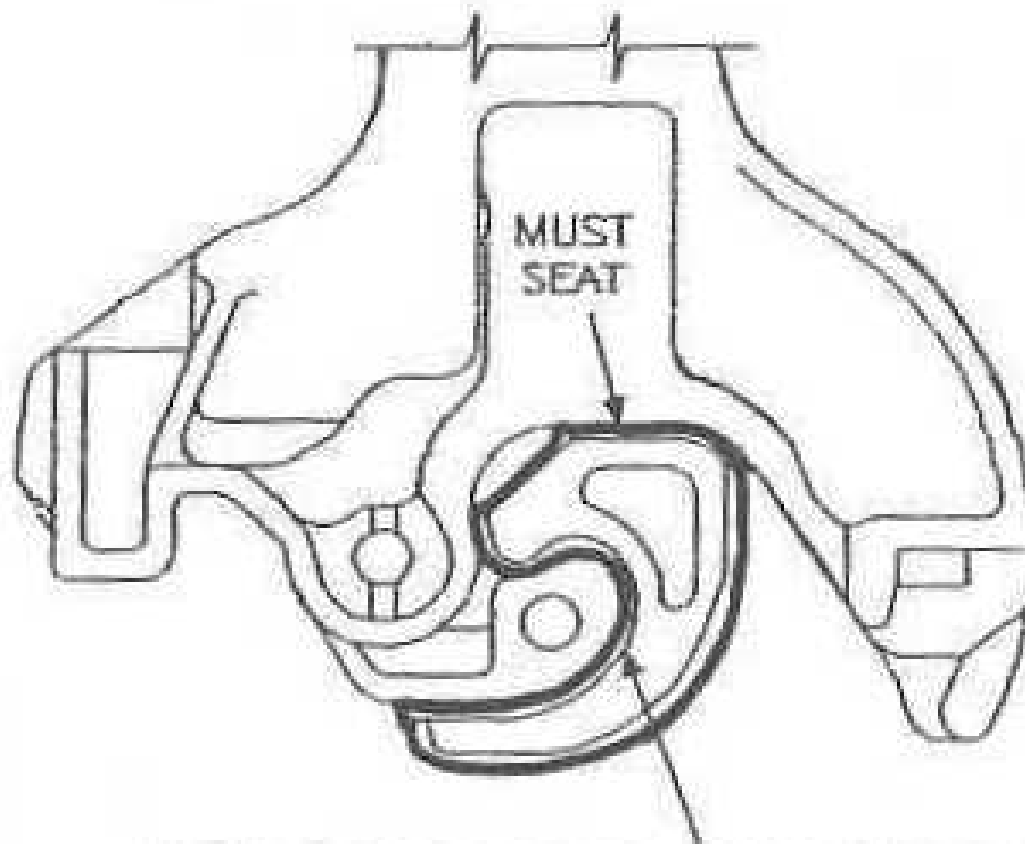
Knuckle contour (profile) check :

Check the contour of the knuckle using the “ **Contour maintenance Gauge** .

Shake the knuckle while passing the gauge.

This is to ensure that slack in the assembly is included in the profile.

If gauge does not pass, Knuckle and coupler head must be checked and replace it or lock to be modified per APTA standards.(American Public Transportation Association)



GAGE MUST PASS THROUGH CONTOUR
WITH KNUCKLE FULLY CLOSED AND
LOCKED.

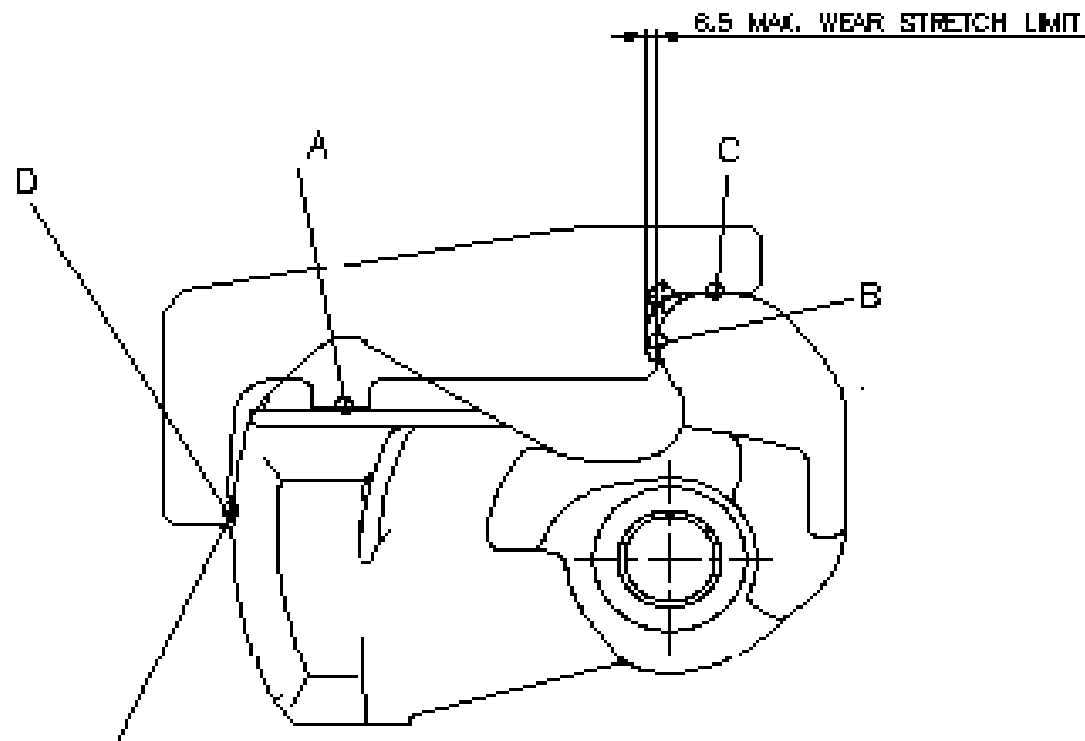
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Knuckle nose wear and stretch limit gauge

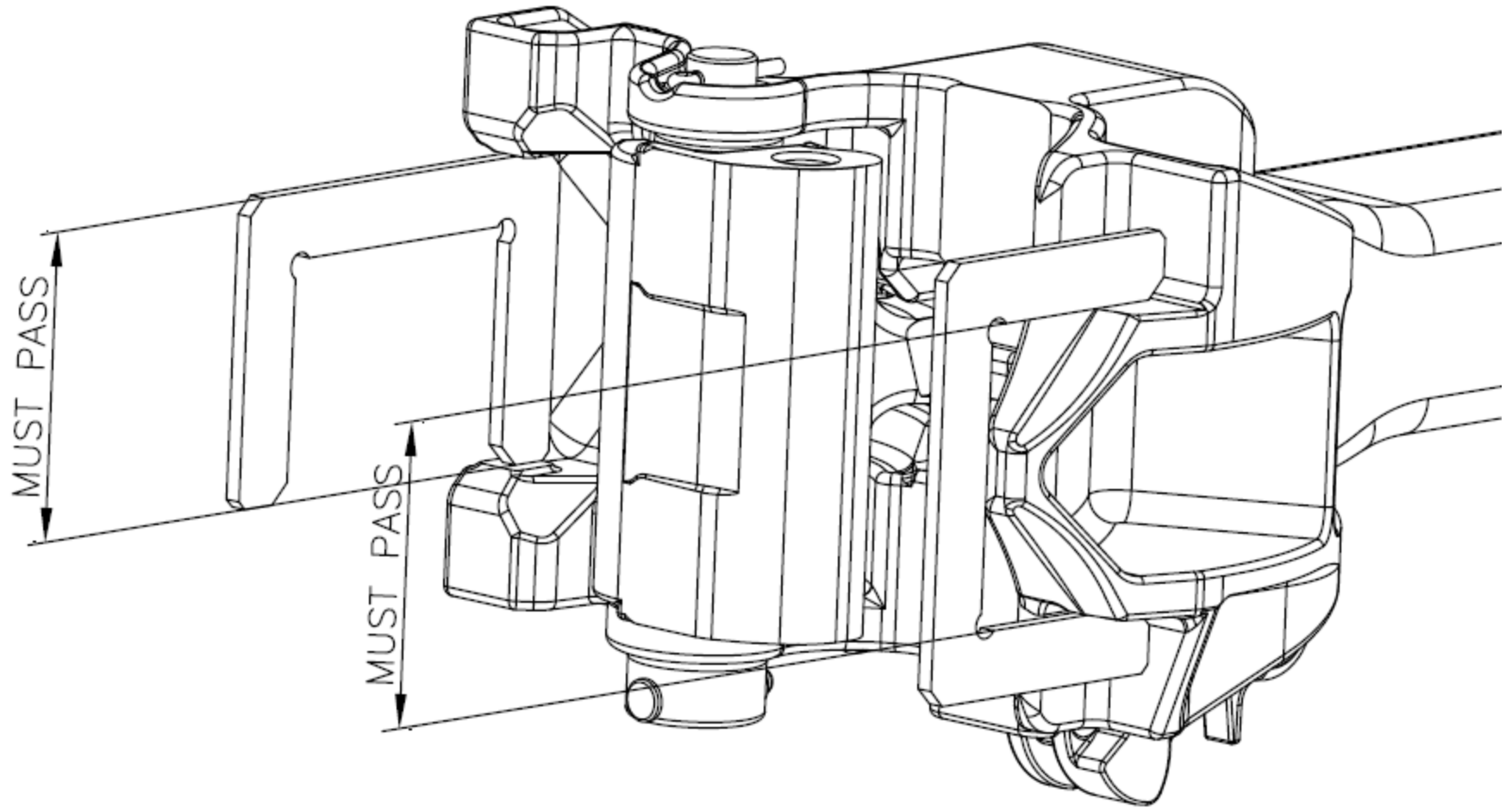
The permitted wear at the nose side is 6.5 mm.

Instruction to use the gauge

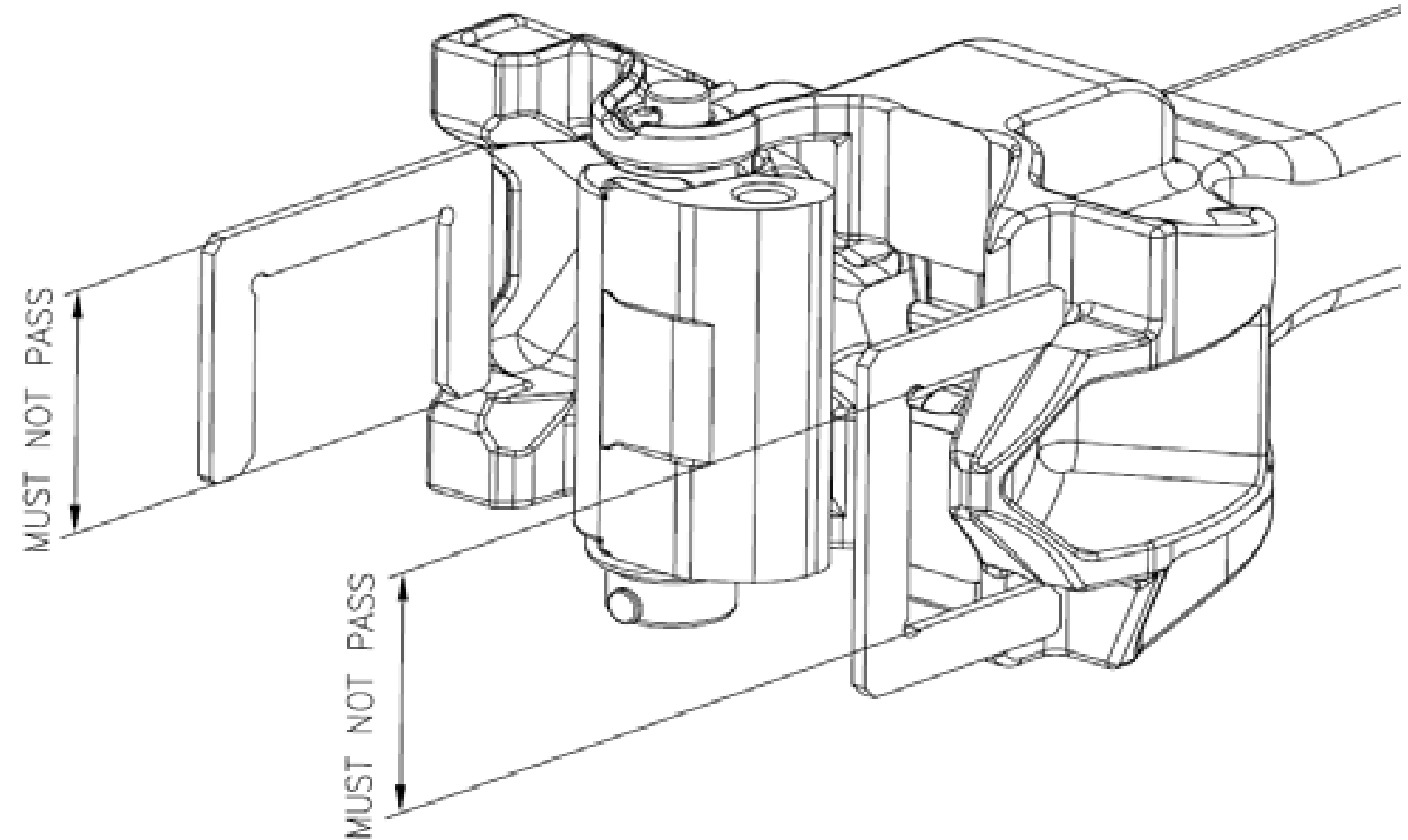
- 'D' must not touch or clear with A,B and C seated.



Vertical height aligning wing pocket and guard arm gauge (GO)



**Vertical height condemning limit aligning wing pocket and guard arm gauge
(NO GO)**



THANK YOU