Locomotive Alignment Control
&
Derailment Prevention

Know Thy Couplers and Draft Gear

TIER 5 LOCOMOTIVE LLC
Established 2013

RAILWAY 2023 INTERCHANGE
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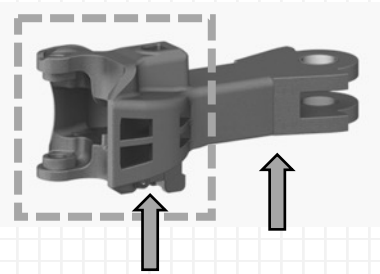
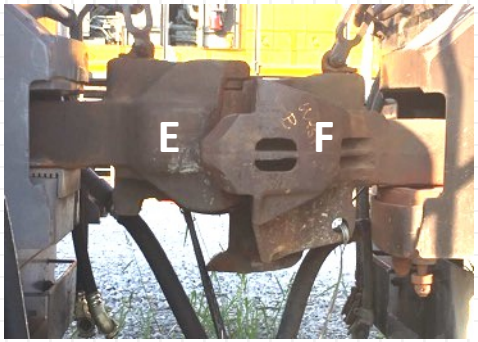
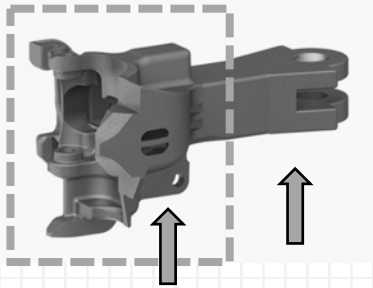
Freight locomotive coupler nomenclature



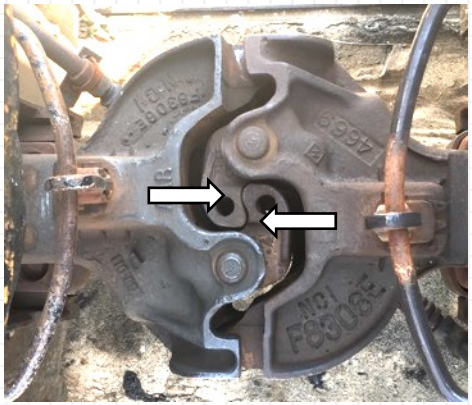
Type **E** head shank



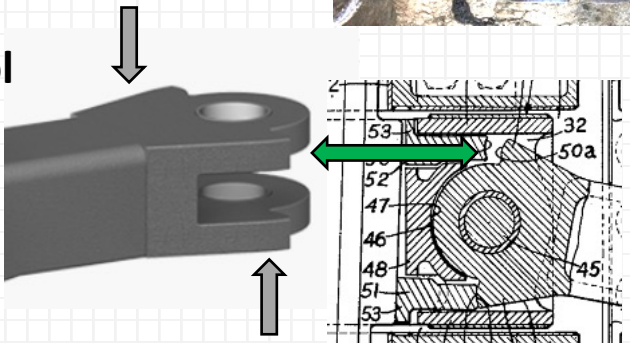


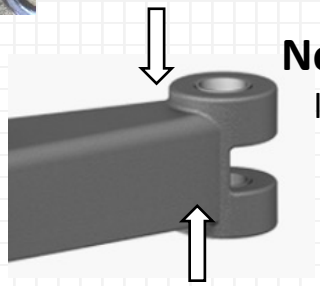
Type **F** head shank

Knuckles (shown: F coupled to F)



Alignment control
"wings" on shank at coupler pin





Non-alignment control
lacks "wings" on shank at coupler pin

Importance of revisiting “alignment control”

- 6-axle high-HP DC-or-AC locomotives most common power for freight trains
- Very-high Dynamic Brake capabilities
- Longer & heavier trains
- High buff forces can act on locomotives
- Especially descending grades, decelerating, moving through curves & crossovers
- Occasional movement of lighter 4-axle loco. (freight & passenger) w/o alignment control couplers & draft gear

- Under the “wrong circumstances” non-alignment control-coupler locos. can cause derailments due to wheel climb or rail rollover!

Brief discussion re “alignment control” within LMOA, 2009

ALIGNMENT CONTROL COUPLER REQUIREMENTS

Prepared by,
George W. King, II,
New York, Susquehanna & Western Railway

Interchanging locomotives not equipped with alignment control draft systems is a source of frustration within the short line community. Many connecting carriers will refuse to transport locomotives over their lines if not equipped with proper alignment control.

Why do many carriers take this stance? Non alignment units have been identified as the root cause of numerous derailments. Analysis of these derailments found severe uncontrolled lateral movements during buff and draft events being a major contributing factor. As a result many carriers refuse to move foreign locomotives that are not equipped with alignment control.

What is alignment control as it relates to locomotive couplers?

Alignment control draft systems use a mechanical means to control lateral movement of the coupler. This normally consists of specific couplers that use wings to compress wedges that push against the draft gear in the direction of swing. Non alignment systems do NOT cushion nor control lateral forces.

Figure 1 displays the difference between alignment and non alignment control locomotive draft systems.

Why does this issue exist?

Locomotives often were not equipped with alignment control due to the service application for which they were destined. Non A/C allows for a tighter negotiated radius with successful coupler operation. Application of A/C reduces the operational ability of the platform in question.

As can be seen in Figure 1 full alignment control coupler swing is limited to 17”. Non alignment control allows for twice the travel as measured in the arc of the movement. Thus non alignment control draft systems are best suited for many industrial applications and track engineered to standards that existed decades ago.

Compliance impact

- Cost
- Practicality
- Operational Needs

Action plan

Contact all carriers involved in the transport from origin to destination. Ascertain each carriers requirements, any and all movement restrictions, train marshalling standards and obtain documentation clearly stating the same. Establish a list of contact names and numbers for each railroad in the event of an unforeseen stoppage in the transport plan.

Possible solutions

- *Coupler lateral stops*

Not a true alignment control system. The blocks are sometimes welded in the coupler pocket or bolted in place to limit the lateral swing of the coupler. This is very cost effective and easily removable thus returning the unit to original configuration. This was permissible in many instances two decades ago but is not acceptable in most cases today.

- *Modified alignment control*

This application uses the existing pocket and draft gear mechanism. It requires the installation of an E7321/EMD # 8271631 “horned” coupler and welding two lateral stops in the pocket opening.

The coupler and stops are easily removed to restore the unit to original configuration. This method is somewhat expensive depending upon the availability of the E7321 coupler. This retrofit may or may not be acceptable to some interchange partners.

- *Full alignment control*

This is a very expensive retrofit as it requires purchase of draft gears, couplers and yokes. In addition it requires removal of the existing draft pockets and fabrication of new units to allow for insertion of the alignment control draft system.

This retrofit is not removable due to complexity and cost. Application of full alignment control will reduce the capability of the locomotive to service customers on tight track curvature.

Full alignment control brings the unit into compliance with connecting carriers but at a cost.

There are several companies that perform the different levels of draft system work as described in this paper. Using existing business profiles as listed in the railway industry periodicals and publications will allow one to establish a cost and scheduling time frame to adapt locomotives for interchange movement. The key issue is to fully understand and comply with ALL connecting carrier requirements.

LMOA
Locomotive Maintenance Officers Association

Proceedings of the 71st Annual Meeting

September 16 - 18, 2009

Chicago Hilton & Towers
720 S. Michigan Ave.
Chicago, Illinois

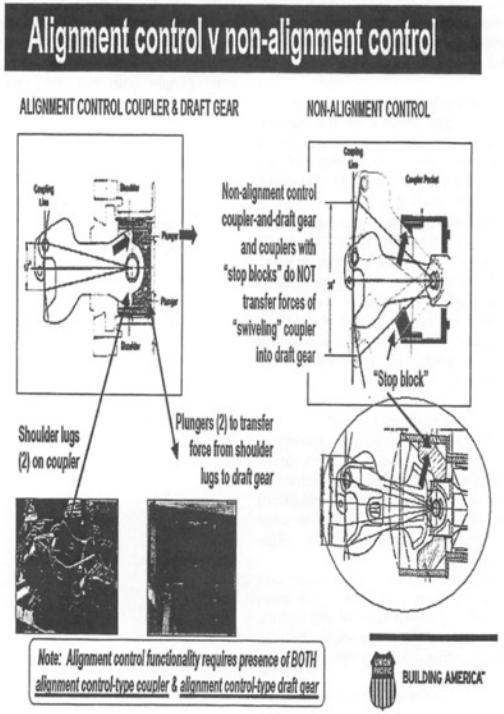
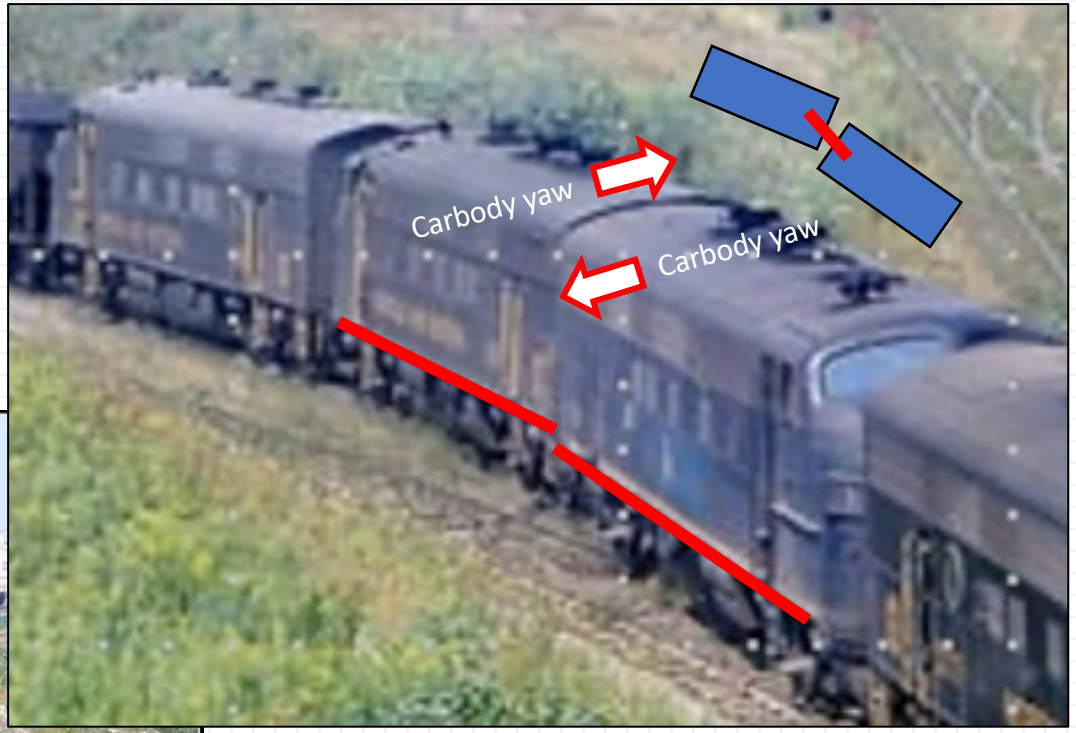


Figure 1

Early diesel derailments (1940s-1950s) without “alignment control”



4 EMD F7 shoving coal train, 1971

Note lateral offset of the 2nd and 3rd units caused by carbody yaw, couplers swung to sides

Non-alignment control units shoving coal train (notice “rotations”)

US Patent 2,754,988 (1956; *expired 1973*) "alignment control for railway vehicles"

July 17, 1956 W. J. METZGER 2,754,978

ALIGNMENT CONTROL MEANS FOR RAILWAY VEHICLES

Filed July 5, 1952 2 Sheets-Sheet 1

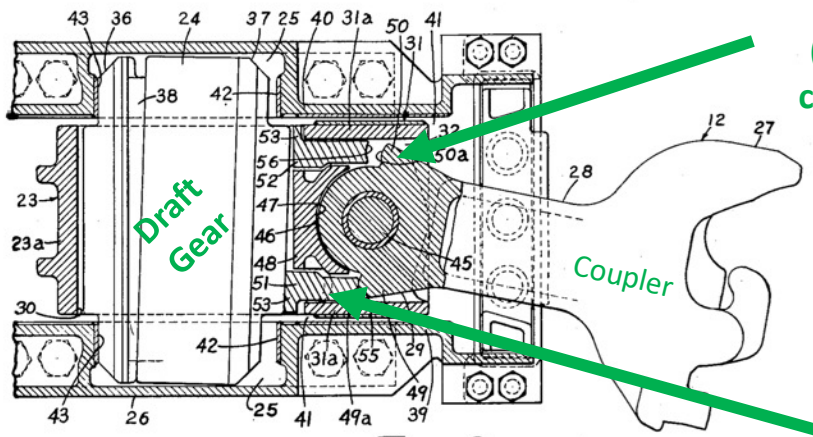


Fig. 3

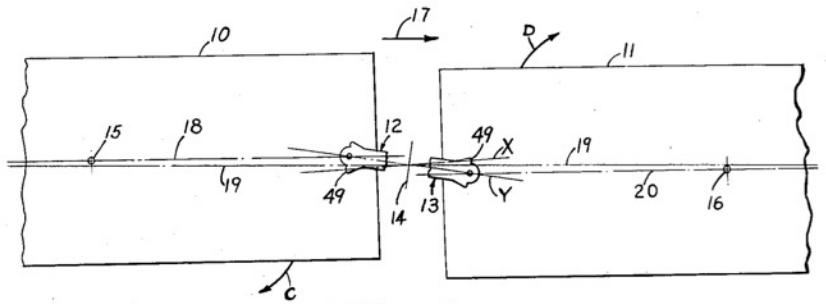


Fig. 1

Abutments ("wings") on coupler shank

Plunger

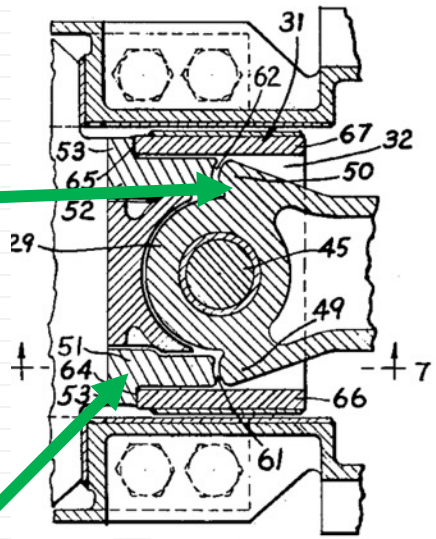
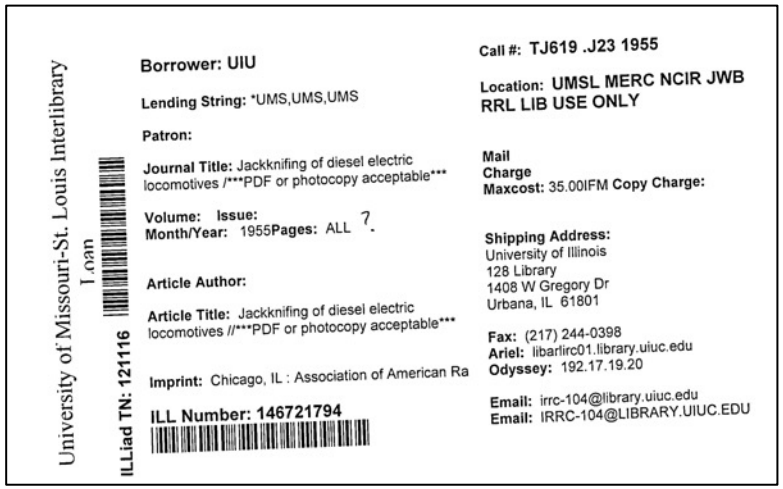


Fig. 6

12. In combination a draft gear yoke, a draft gear in said yoke, said yoke having a hollow forward portion, a car coupler having a shank extending into said yoke portion and being pivotally connected thereto for horizontal angling, said shank having abutments on opposite sides thereof, a pair of longitudinally movable plunger members within said yoke portion, said members being positioned between the forward end of said gear and said abutments, said plungers being spaced from said abutments when said coupler is in central position, means on said yoke for maintaining said plungers in said spaced relationship to said abutments, one of said plungers being engageable by the adjacent one of said abutments upon angling of said coupler laterally from central position a predetermined amount whereby buffing forces applied to the coupler are transmitted by said engaged plunger directly to said gear.

As loco. coupler rotates in buff, lateral forces are redirected back into the draft gear along the loco. centerline

AAR 1955 “jackknifing” analysis of National Castings’ “alignment control”



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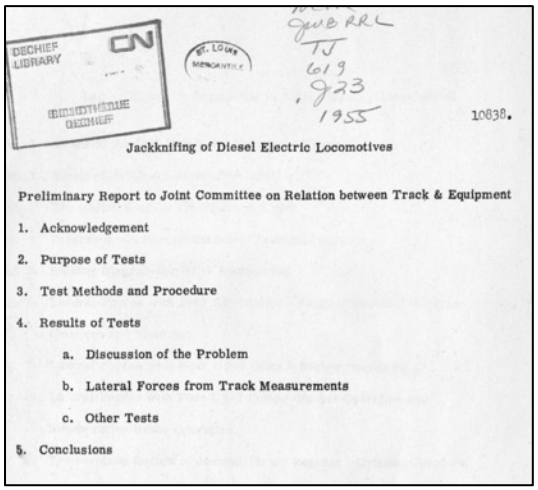

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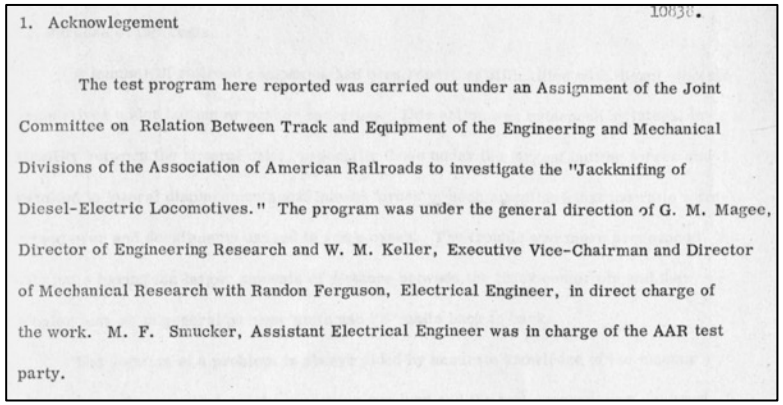
Jackknifing of Diesel Electric Locomotives

Preliminary Report to Joint Committee on Relation between Track & Equipment

1. Acknowledgement
2. Purpose of Tests
3. Test Methods and Procedure
4. Results of Tests
   a. Discussion of the Problem
   b. Lateral Forces from Track Measurements
   c. Other Tests
5. Conclusions



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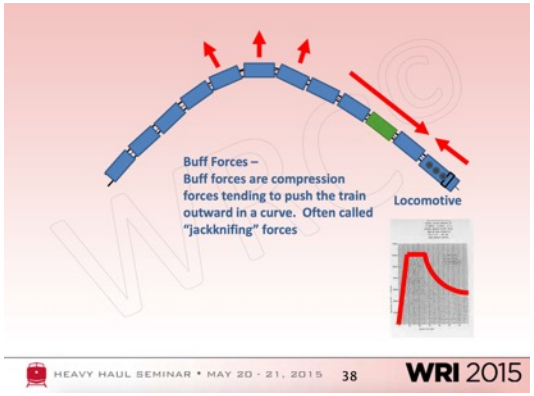
1. Acknowlegement

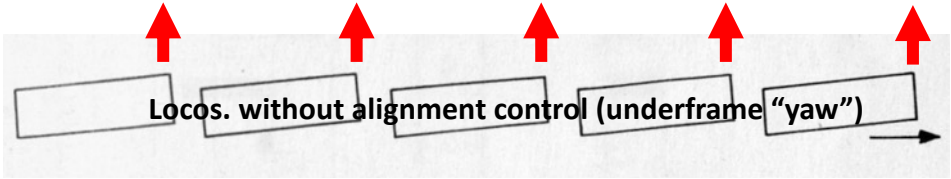
The test program here reported was carried out under an Assignment of the Joint Committee on Relation Between Track and Equipment of the Engineering and Mechanical Divisions of the Association of American Railroads to investigate the "Jackknifing of Diesel-Electric Locomotives." The program was under the general direction of G. M. Magee, Director of Engineering Research and W. M. Keller, Executive Vice-Chairman and Director of Mechanical Research with Randon Ferguson, Electrical Engineer, in direct charge of the work. M. F. Smucker, Assistant Electrical Engineer was in charge of the AAR test party.



Buff Forces –
Buff forces are compression forces tending to push the train outward in a curve. Often called “jackknifing” forces

Locomotive

HEAVY HAUL SEMINAR • MAY 20 - 21, 2015 38 WRI 2015

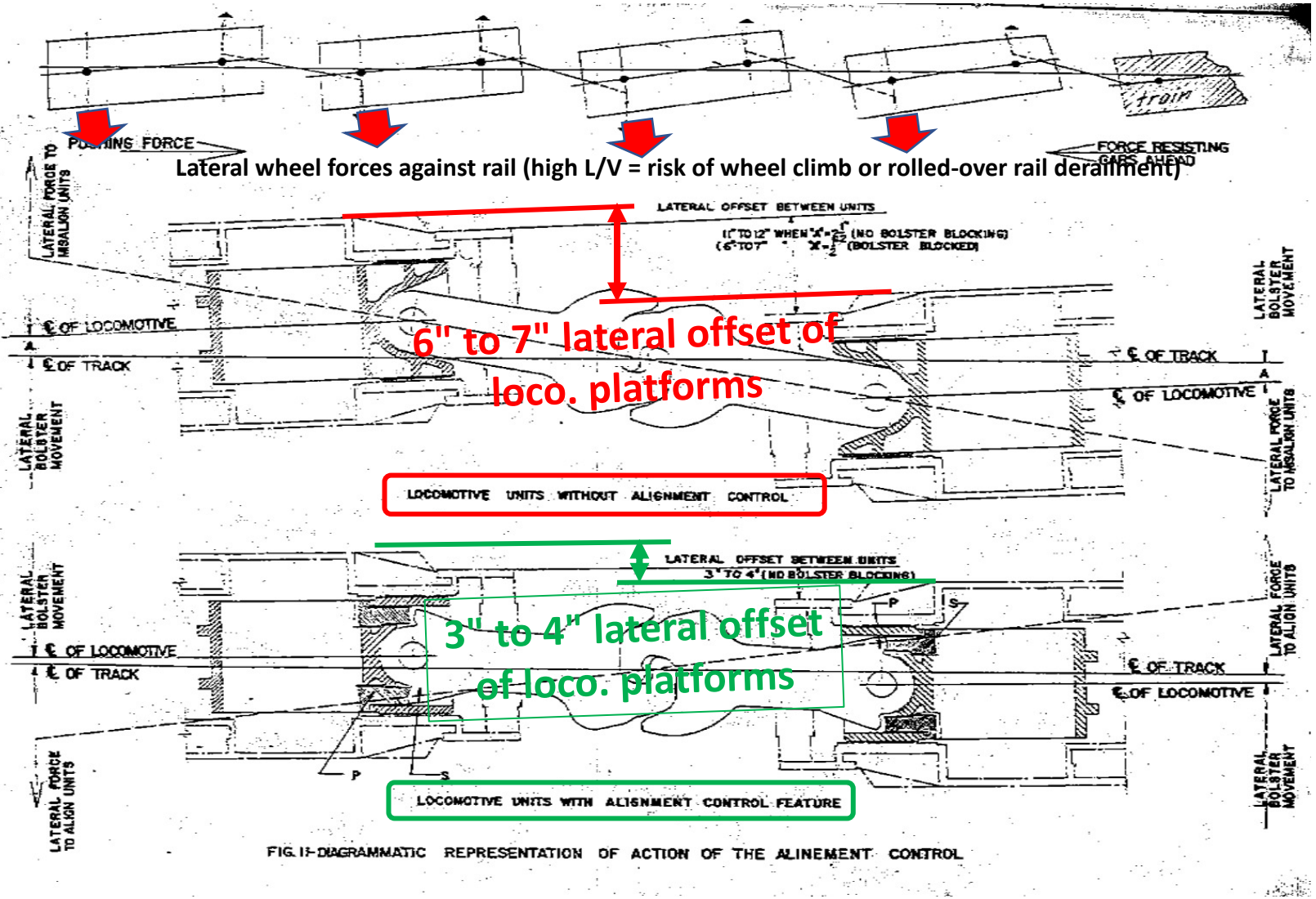


Locos. without alignment control (underframe “yaw”)

Excessive lateral wheel force against rails caused by locomotive coupler angularity can cause wheel climb or rail rollover

Alignment Control v Non-Alignment Control tests (AAR), 1954

Typical jackknifing pattern of unrestrained locomotives in heavy buff loading ("Z pattern")



TRB summary of AAR 1955 analysis of loco. jackknifing & “alignment control”

trid.trb.org

JACKKNIFING OF DIESEL ELECTRIC LOCOMOTIVES REPORT OF THE JOINT COMMITTEE ON RELATION BETWEEN TRACK AND EQUIPMENT

A number of railroad companies had been reporting difficulties with diesel electric locomotives under buffing or pusher operation. This action was evidenced by lateral instability between the several units, especially those under the largest buffing forces and resulted in lateral displacements and lateral forces of such magnitude that the rails were turned over and derailments caused in some cases. To obtain as complete an understanding of the jackknifing action as possible it was decided to make measurements on both the locomotive and the track. A test location was picked on a right curve of 8 deg. 6'. The grade was 1.72 percent at the curve but within a mile became 2.20 and 2.40 percent so that part of the train on the steeper grade when the recordings were made. The rail was 131 lb. RE Section laid in 1946 and rather badly curve worn. The test locomotives were GP-7 Electro Motive general purpose road switchers. The following conclusions were drawn: Jackknifing is the result of lateral instability of the several units and its severity is dependent on the magnitude of the buffing force and the eccentricity of the force. It is evident the eccentricity of the force will depend on the amount of overhang and the clearance available for lateral movement. Reduction of the bolster clearance to a small amount improves the conditions sufficiently that operation is not excessively difficult. Lateral forces are reduced about 50 percent. Operation of the general purpose units with full bolster clearance and standard couplers under buffing forces is not practicable with four units and probably undesirable with three units. Forces of almost 25,000 lb were measured at 10 mph and 140,000 to 175,000 lb tractive force and higher forces can be developed at lower speeds or under impact conditions. These laterals applied continuously will be very detrimental to rail and wheels, cause journals to run hot, and may cause derailment. The use of the alinement control coupler attachments reduced the forces to a normal amount for the curvature of the test location. The lateral forces under full regenerative braking with alinement control couplers for an undetermined reason were a little higher in the few tests made than in the pusher operation which had twice the tractive force. However, they are still quite moderate. The jacknife position, once assumed, remains until the train is stretched out.

Corporate Authors:
Association of American Railroads
50 F Street, NW
Washington, DC United States 20001-1564
Authors:
MAGEE, G M
Keller, W M
Ferguson, R
Publication Date: 1955-1

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Pagination: 21 p.

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Uncontrolled Terms: Contact stress; Draft gears; Lateral dynamics; Vertical dynamics
Geographic Terms: United States
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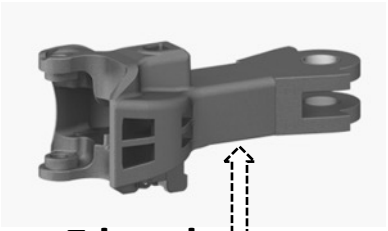
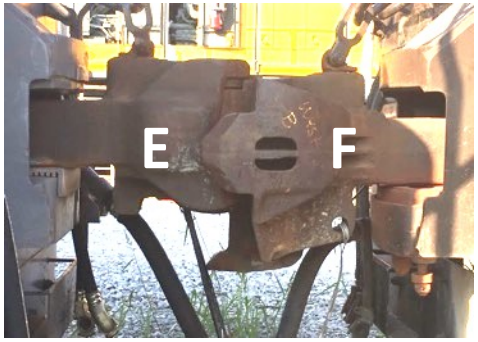
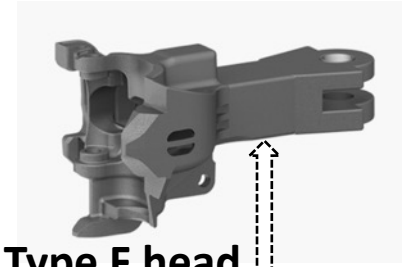


Type E head

E requires a standard “non-sprung” coupler carrier to support shank (allows side-side swing only) … should NOT have F carrier!



Type E coupler (left) coupled to Type F coupler (right)



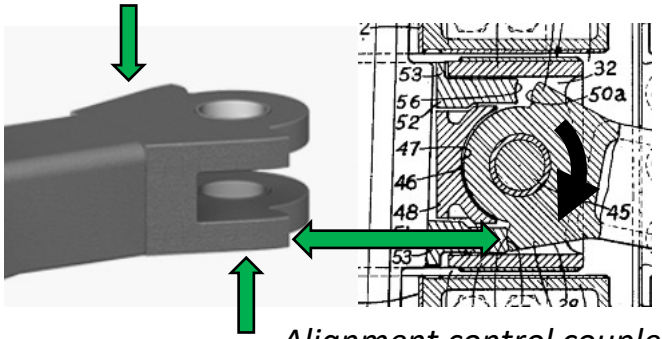
Type F head

F requires a “spring supported” coupler carrier to support shank (allows side-side AND vertical swing) … should NOT have an E carrier!

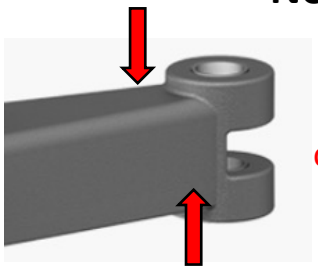
Alignment control shank

“wings” on shank at coupler pin to engage “plungers” inside draft gear

Maximum side-side swing is 17° or 4” to either side of centerline



Alignment control coupler shank is shown rotated to one side engaging “plunger” redirecting force toward centerline of locomotive (instead of to side)



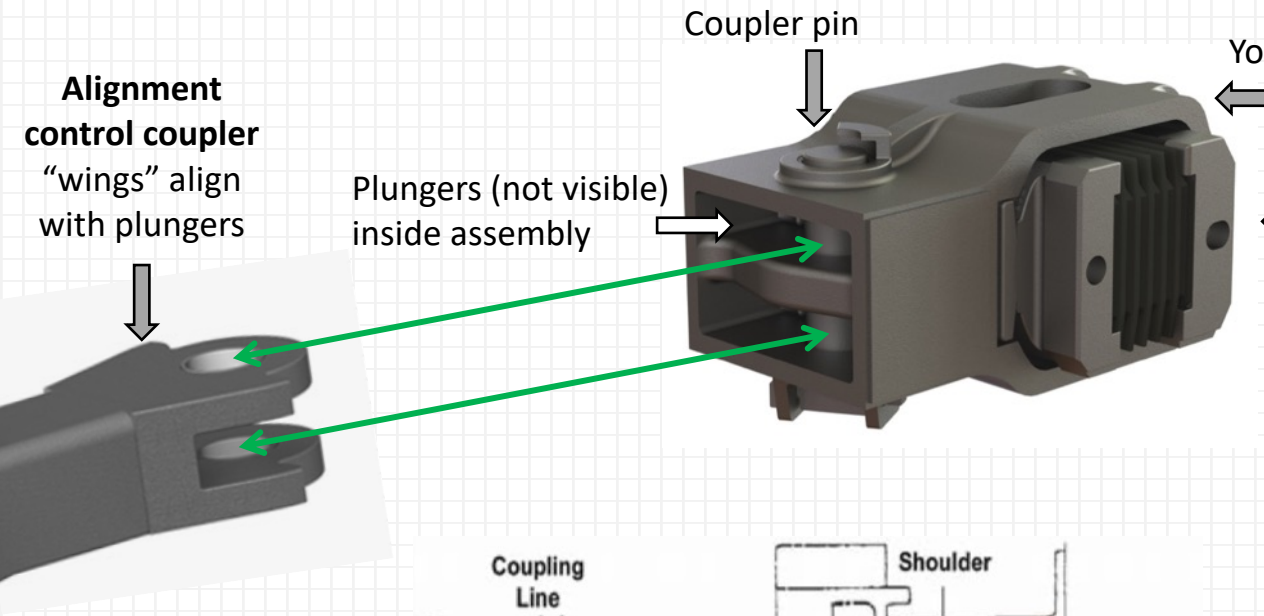
Non-alignment control shank

does not have “wings” on shank at coupler pin

Maximum side-side swing is 38° or 8” to either side of centerline

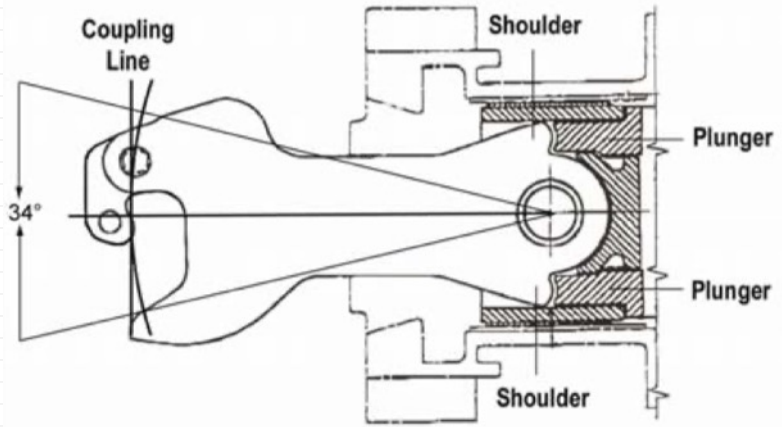
Coupler & Draft Gear illustrations courtesy of Wabtec

Locomotive alignment control nomenclature



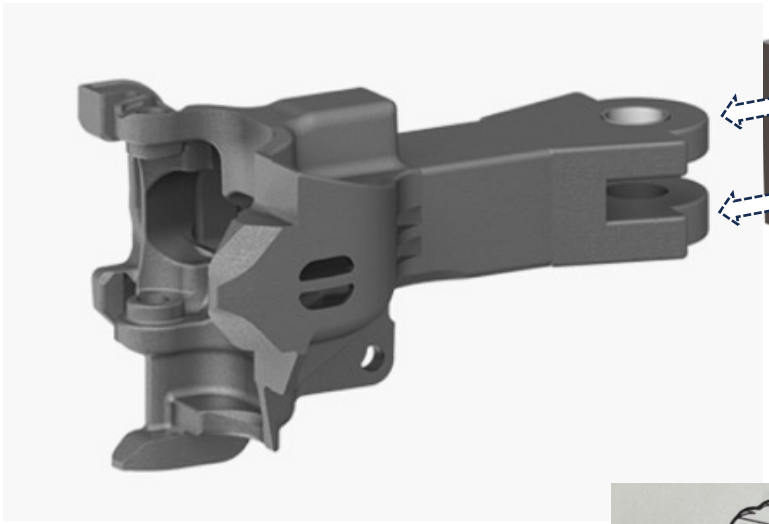
NC390 (type E or F) and NC391 (type E-only) draft gear shown

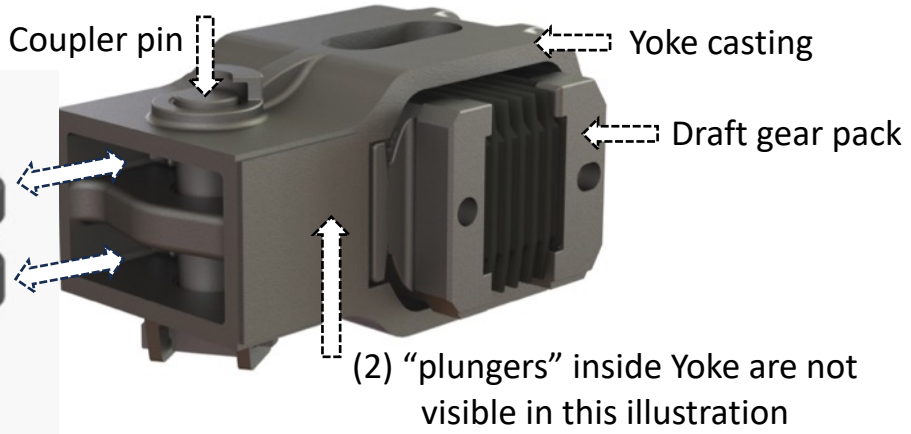
(Older M380 and M381 draft gear are similar)

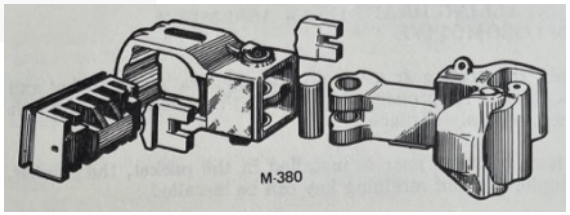
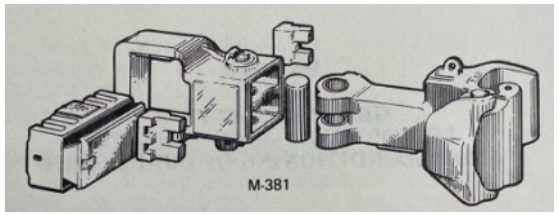
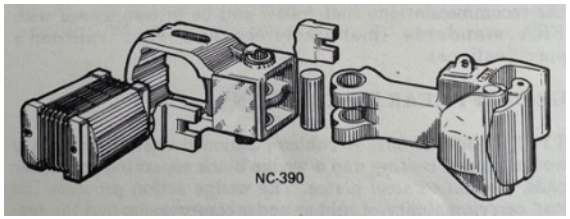
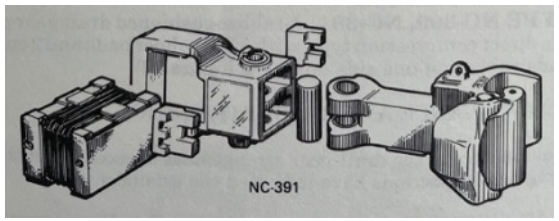


Alignment Control Coupler (type F shown) ⇔ **Cplr. Pin** ⇔ **Yoke** ⇔ **Draft Gear** ⇔ **Loco. Platform (Underframe)**

Plunger (cplr. swung, buff) ⇒ ⇒





	E-or-F coupler:	E coupler (only):
Type 380 & 381 D.G. (pre ~1965 like GP35s & U25Bs:		
Type 390 & 391 D.G. (post ~1965 like GP40s & U30Bs:		

Coupler & Draft Gear illustrations courtesy of Wabtec and Simmons-Boardman Publishing Co.

Large High-HP Units w/ Alignment Control pulling the train (“draft” condition)

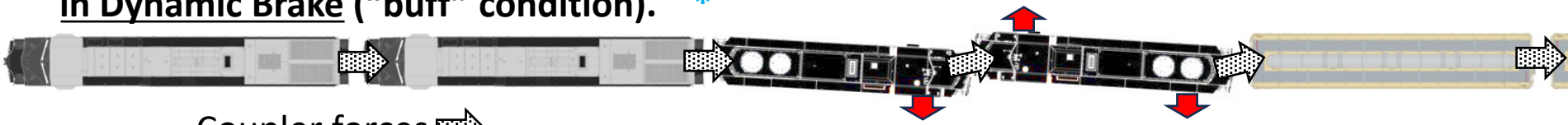
Non-Alignment Control Units

Trailing train (in “draft” condition)

⇦ Coupler forces

When train is in draft condition (couplers “stretched”), non-alignment control units are “in line”

Large High-HP Units w/ Alignment Control in Dynamic Brake (“buff” condition). *



Coupler forces ⇨

When train is in buff condition (couplers “bunched”) due to dynamic braking, non-alignment control unit platforms are forced to rotate (pivot) to sides because of lateral (sideways) coupler forces … and wheels can exert high lateral forces on rails leading to derailment

Alignment Control keeps the units with high dynamic braking forces “in line” with minimal coupler & platform rotation (pivoting)

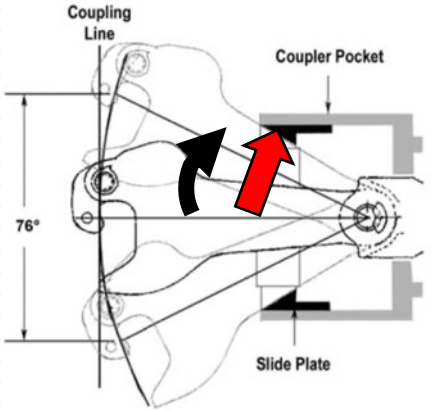
* The rear-most alignment control coupler tends to keep the forward-end of the front-most non-alignment control unit “in line”

The “zig zag” pattern remains until the train is “stretched”

“Stop Blocks” do not reduce the lateral forces; they simply limit coupler swing!

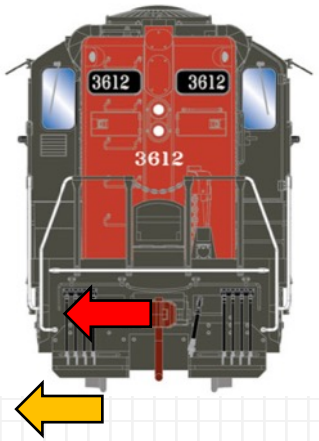
How “alignment control” manages lateral coupler forces

Non-alignment control coupler has 76° of “swing” (38° to each side = 8” to each side)



WHEN NON-ALIGNMENT CONTROL COUPLER SWINGS TO MAXIMUM IT WILL STRIKE COUPLER POCKET (OR STOP BLOCK) AND IMPART A LATERAL FORCE ON LOCOMOTIVE UNDERFRAME.

LATERAL FORCE WILL THEN BE TRANSMITTED TO WHEELS AND RAILS ON THAT SIDE OF LOCOMOTIVE.

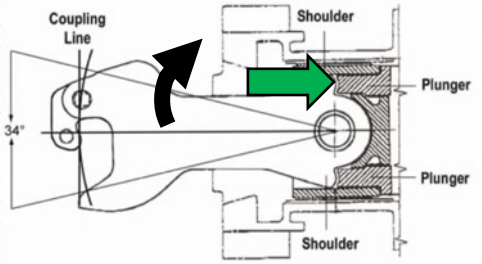


High coupler lateral force results in high lateral wheel force against rail

STOP BLOCKS DO NOT REDUCE LATERAL FORCES!

WHEN ALIGNMENT CONTROL COUPLER SWINGS TO MAXIMUM, THE COUPLER “WINGS” CONTACT THE DRAFT GEAR PLUNGERS, LIMITING COUPLER SWING, AND REDIRECTING LATERAL FORCE BACK INTO DRAFT GEAR AND CENTERLINE OF LOCOMOTIVE.

Non-alignment control coupler has 34° of “swing” (17° to each side = 4” to each side)

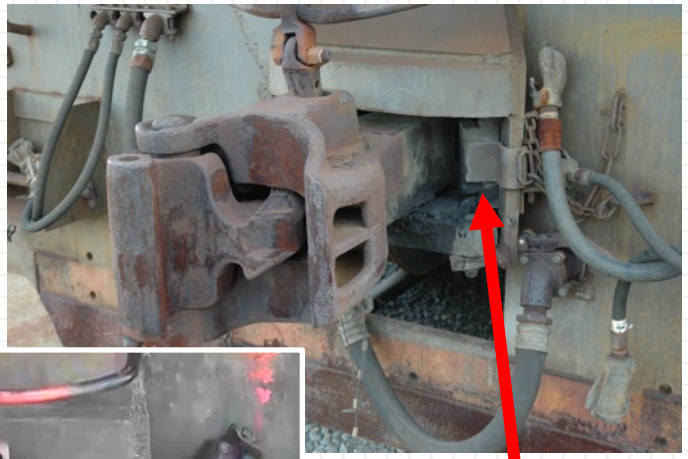


COUPLER WILL NEVER STRIKE SIDE WALL OF COUPLER POCKET.

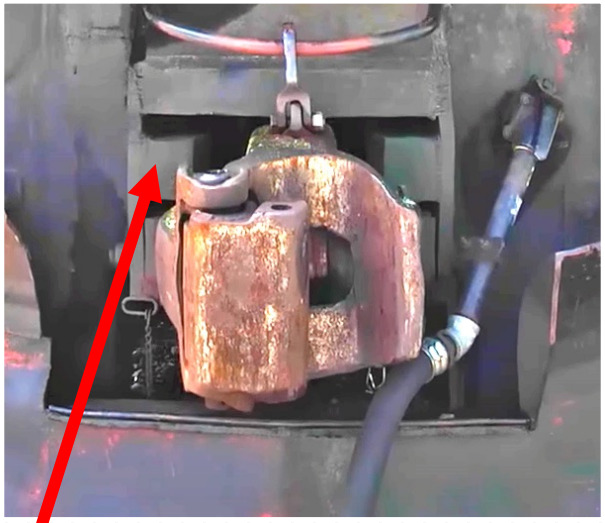
Drawings reproduced from TSB Canada accident report R05C0082 (2005)

THIS MINIMIZES LATERAL FORCE BETWEEN WHEELS AND RAILS.

Alignment control “plungers” v non-alignment control “Stop blocks”



Temporary “clip on” stop blocks



“Welded on” stop blocks
(this is 1 of 2 GP9s involved in March 2023 derailment on NS at Anniston, GA)

Drone camera screen shot from: https://www.youtube.com/watch?v=jI9ut7LThuc

Recent "jackknife" derailments, non-alignment control locomotives

July 26, 1992 UP Evanston, WY **3 SD60** w/ **5 waybill F59PH DIC** & 92 cars
FRA acc. report **Train in DB descending grade** 25mph thru a 3°40′ curve
Non-equipped 3rd, 4th & 5th F59's derailed + 17 freight cars derailed

Oct. 31, 1999 ARR Canyon, AK **3 GP40-2** w/ **2 MP15 DIC** & 46 cars (5,477 tons)
FRA acc. Report **Train in DB**
Non-equipped 2 MP15s derailed + 10 cars (HZM, jet fuel spill)

July 8, 2002 CN Camrose, AB **3 SD60-70-75** w/ **2 DIC GP9** & 150 cars (17,201 tons)
TSB Canada report **Train in DB descending 0.7% grade** to a 6° curve
Non-equipped 2nd of 2 GP9s derailed + 26 cars derailed

May 27, 2005 CP Bowden, AB **2 AC4400** w/ **2 DIC GP9** & 77 cars (4,512 tons)
TSB Canada report **Train in full DB at work zone**, then into power and accelerated
Non-equipped 2 GP9s derailed + 24 cars derailed

February 2010 CSX LaGrange, GA **2 AC4400** & **5 DIC SW1500** + unknown train
FRA acc. report **Unknown train handling**
Non-equipped 5 SW1500 derailed + unknown cars derailed

March 30, 2010 CN Pickering, ON **3 SD70** w/ **4 waybill F59PH** & 149 cars (12,166 tons)
TSB Canada report **Med-to-full DB decelerating and approaching a crossover**
Non-equipped 4 F59PHs derailed + 11 cars derailed

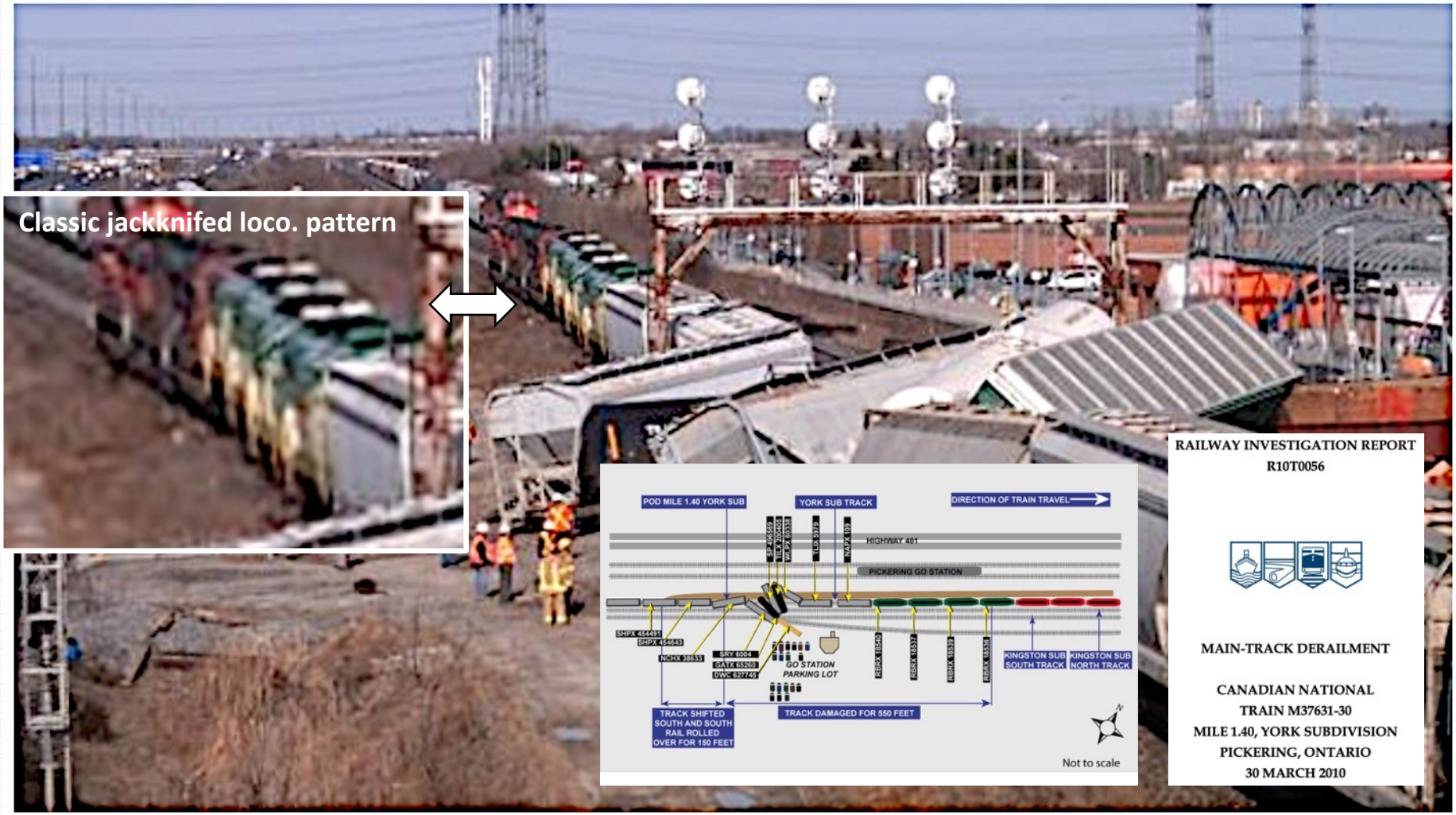
(Spring) 2014 UP Nelson, IL (?) **2 SD9043AC** w/ **1 DIC MP15DC** & train
Personal inspection **Train in DB through mainline crossover**
Non-equipped MP15DC derailed + unknown number cars derailed

March 7, 2018 CSX Sherwood, TN **2 AC** w/ **2 DIC F40PHM** & 177 cars (14,837 tons)
FRA acc. report **Train in DB descending mountain grade**
Non-equipped 2 F40PHM & 13 cars derailed (**1 F40PHM destroyed**)

March 9, 2023 NS Anniston, GA **2 AC + 2 DC** w/ **2 waybill GP9** & 106 cars
NTSB report **Train in DB descending grade exiting a curve**
CNN video **Non-equipped both GP9s derailed** & 29 cars (+8 cars @ rear) derailed

Non-equipped waybilled SW1500s derailed, LaGrange, GA, 2010

CN, Pickering, ON, March 30, 2010



The derailment on CN's rail line near the Pickering GO station on Tuesday, March 30, 2010 left a jumbled mess of cars. (Rob McDonell / MyNews.CTV.ca)

Non-alignment control F40PHM destroyed, Sherwood, TN 3-07-2018

NS, Anniston, GA, March 9, 2023

https://www.youtube.com/watch?v=jI9ut7LThuc

UP AC	UP AC	NS SD60M	NS SD60M	***GP9 DIC***	***GP9 DIC***	108 car train

Non-alignment control

Special issues w/ Passenger & Commuter locos.

- Many passenger & commuter locos. Have non-alignment control couplers
- Passenger and commuter locos. typically operate “outside” freight operations
- But they occasionally are transported (waybilled), relocated by freight RRs
- New PRIIA-spec. passenger locos. have Crash Energy Management pushback couplers with no alignment control cpability

Passenger & Commuter locos. w/o alignment control

PRIIA psgr. "pushback" coupler w/o alignment control

Illustration from:
https://www.regulations.gov/document/FRA-2017-0041-0001

Commuter loco. Type F coupler w/o alignment control

Pin-connected shank with NO alignment control functionality

"Shear tube" w/ 9" crush length

F coupler head

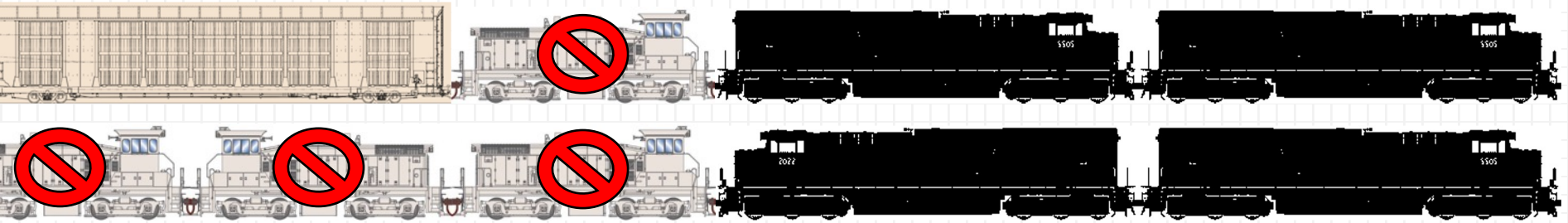
https://www.dellner.com/products/automatic-couplers/automatic-coupler-type-aar-pushback

What can be done to eliminate derailment of nonalignment control locos?

- Future new freight locomotives should all have alignment control
- If special need for “sharp curvature operation” non-alignment control “OK” but locomotive(s) must have visible placarding and Umler warning plus appropriate RR instructions for TE&Y jamdling and placement in trains
- Existing “legacy” locomotives w/o alignment control will likely continue to exist
- Occasional movement (waybill or other) of legacy locomotives will happen
- RRs moving legacy locomotives must have proper instructions
- Suggest AAR Op. Practices Committee develop “best practice” requirements for how legacy locomotives w/o alignment control are transported

Recommended movement ⟹ of non-alignment control locos. (MU capable)

RECOMMEND TO AVOID: DO NOT PLACE 1-OR-MORE BETWEEN HEAD-END CONSIST AND TRAIN



Non-alignment control, either DIC or under power

Alignment Control & Dynamic Brake

Alignment Control & Dynamic Brake

Note: This also applies to non-alignment control passenger locos.
Note: If passenger unit is PRIIA spec., see next page..

All units are fully MU'd

RECOMMENDED: ONLY 1 NON-ALIGNMENT CONTROL LOCO. PER HEAD-END CONSIST UNIT PLACED BETWEEN 1ST & 2ND ALIGNMENT CONTROL UNITS

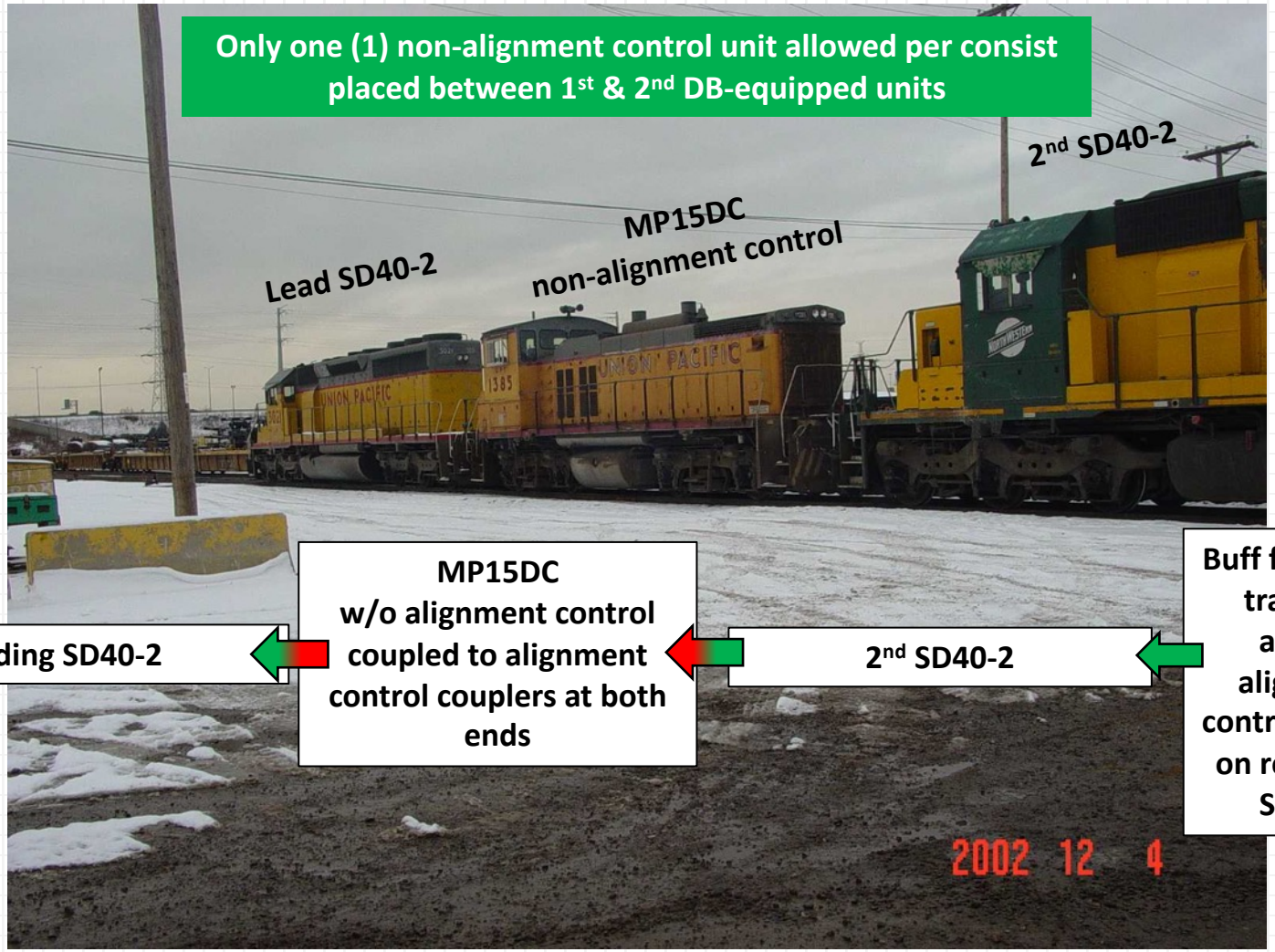
Alignment Control & Dynamic Brake

Non-alignment control (freight or passenger)

Alignment Control & Dynamic Brake

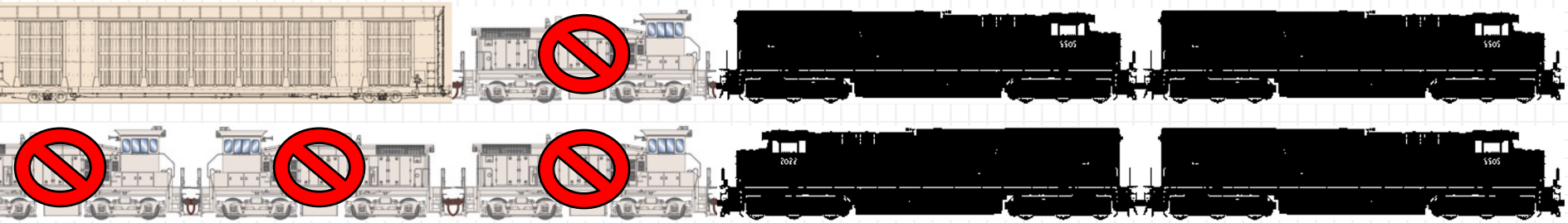
All units are fully MU'd & non-alignment control unit BETWEEN 1st & 2nd equipped units

Handling non-alignment control switchers on UP, 2002 (“by the Rule”)



Recommended movement ⇨ of non-alignment control locos. (w/o MU)

RECOMMEND TO AVOID: DO NOT PLACE 1-OR-MORE BETWEEN HEAD-END CONSIST AND TRAIN



Non-alignment control, Dead in Consist (DIC) and not MU'd

Note: This also applies to non-alignment control passenger locos.

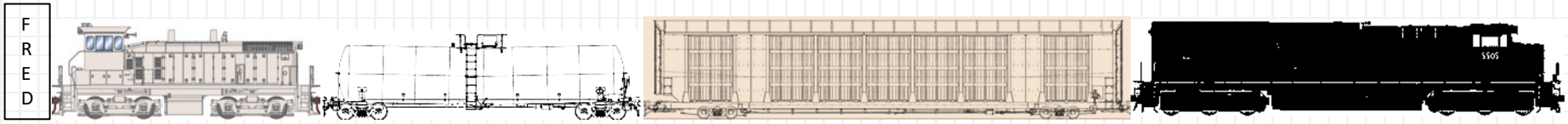
Note: If passenger unit is PRIIA spec., see next page..

Alignment Control & Dynamic Brake

Alignment Control & Dynamic Brake

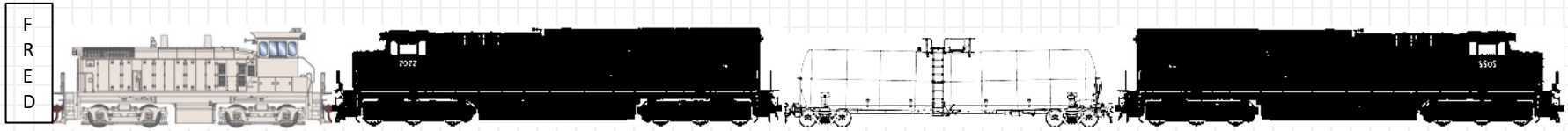
Head-end consist is MU'd

RECOMMENDED: ONLY 1 NON-ALIGNMENT CONTROL LOCO. W/O MU CAPABILITY PER TRAIN UNIT PLACED AT REAR OF TRAIN CONSISTENT W/ OTHER CAR PLACEMENT RESTRICTIONS



Non-alignment control w/o MU capability (freight or passenger)

Alignment Control & Dynamic Brake



Rear-end DP loco.

Recommended movement ⟹ of PRIIA pushback coupler locos.

RECOMMEND TO AVOID: DO NOT PLACE 1-OR-MORE BEHIND HEAD-END CONSIST AND TRAIN

PRIIA passenger loco. w/ Pushback Couplers

Alignment Control & Dynamic Brake

Alignment Control & Dynamic Brake

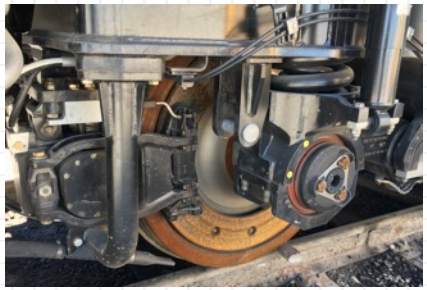
1-OR-MORE PRIIA PUSHBACK COUPLER PASSENGER LOCOS. MOVED AS A SPECIAL TRAIN WITH NO TRAILING FREIGHT TONNAGE

NO trailing freight tonnage

1-or-more PRIIA passenger loco(s). w/ Pushback Couplers

Alignment Control & Dynamic Brake

All units are fully MU'd



CAUTION: If PRIIA locos. are set-up DIC, brakes will not bail off on long descending grades!

Risk of braking discs overheating causing wheels to loosen, shift inward on axle

AAR Op. Practices Committee recommended actions

- Consensus approach to handling locos. w/o alignment control:
  - How to safely handle locos. w/o alignment control couplers/draft gear
  - “Safely” means minimized risk of wheel-climb/rail-rollover derailments
  - See (3) “recommended handling” slides

- Proper handling & positioning of locos. non-alignment control
  - Number of non-equipped units per “working consist” (limit to one (1))
  - Need for complete air & electrical MU capability (otherwise end of train)
  - Acceptability (or absence) of “stop blocks” (recommend none)

- Special knowledge and attention to new PRIIA-spec. passenger locos.
  - Psgr. Locos. DO get transported by freight railroads
  - “Pushback couplers”
    - Extreme coupler swing
    - No alignment control functionality
  - Many PRIAA locos. also have wheel plate-mounted braking discs
    - Cannot bail off BP reduction w/ Dead Engine Feature cut-in
    - Risk of overheating brake discs and loosening wheel on axle

AAR Locomotive Committee recommended actions

- Create definition of “alignment control”:
  - Presence of alignment control draft gear, models M380/M381/NC390/NC391*
    - Wabtec refers to Mark 390/Mark 391
  - Presence of alignment control coupler with “alignment wings”
  - Excludes presence of “stop blocks” (welded-in or removable, steel or rubber)

- Create Standard mandating presence of “alignment control”:
  - New/remanufactured freight locos. at effective date _____, 20__
  - Loco. Owner can opt for non-alignment control couplers but must placard unit above couplers

- Create Standard placard to be applied any non-alignment control locos. moving within the freight environment:
  - CAUTION NON-ALIGNMENT CONTROL

Shipment of a commuter locomotive with (temporary) alignment control coupler

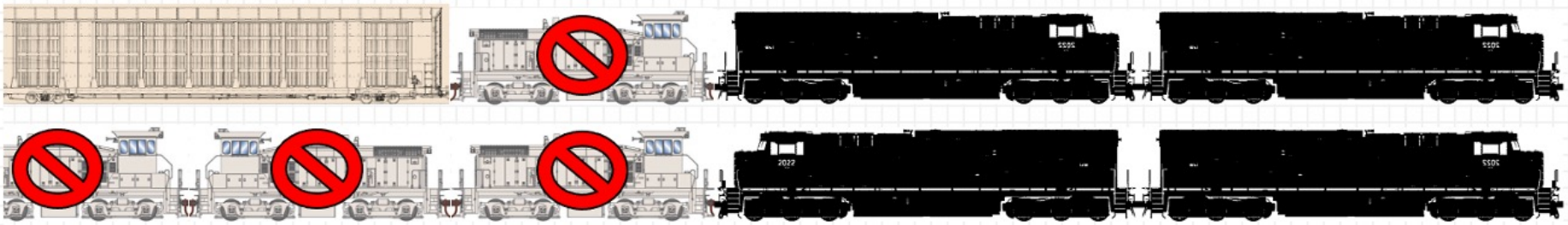
Placard decal above coupler (both ends) reading
“SELF ALIGNING COUPLER-MPEX"

… providing advise to any RR personnel handling the waybilled locomotive that it has alignment control

If customer did not want alignment control, MPI-Boise would replace on arrival at customer

Recommended movement ⇨ of non-alignment control locos. (MU capable)

RECOMMEND TO AVOID: DO NOT PLACE 1-OR-MORE BETWEEN HEAD-END CONSIST AND TRAIN



Non-alignment control, either DIC or under power

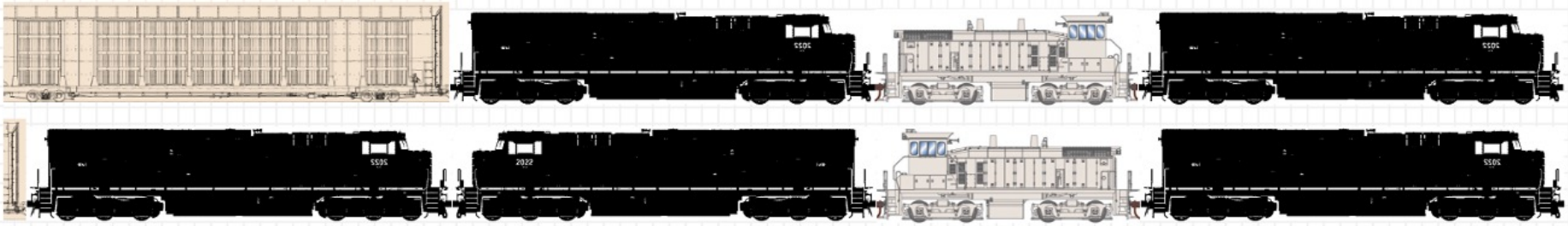
Alignment Control & Dynamic Brake

Alignment Control & Dynamic Brake

Note: This also applies to non-alignment control passenger locos.
Note: If passenger unit is PRIIA spec., see next page..

All units are fully MU'd

RECOMMENDED: ONLY 1 NON-ALIGNMENT CONTROL LOCO. PER HEAD-END CONSIST UNIT PLACED BETWEEN 1ST & 2ND ALIGNMENT CONTROL UNITS



Alignment Control & Dynamic Brake

Non-alignment control (freight or passenger)

Alignment Control & Dynamic Brake

All units are fully MU'd & non-alignment control unit BETWEEN 1st & 2nd equipped units

Q&A and Comments