Hands off Switching of Trolley Freight Trains

Charles C. Robinson, Boston Trolley Meet, April 9, 1994, Lowell, MA.

Summary:

Two big problems

Trolley freight operation with typical interurban freight cars was done around sharp curves and with equipment with radial couplers. These couplers were aligned manually by the freight crews before couplings were made.

*	Interurban freight equipment was equipped with trolley pole pick up. To do switching, it was necessary to back against the pole and to steer the incorrectly raked pole with the trolley rope through the facing direction of the wire frogs.

The clinic will cover the following topics: (The details apply to HO gauge. The ideas can be used in O gauge.)

Automatic radial couplers based on the Kadee magnet coupler that are aligned by a linkage to the trucks. These will couple and uncouple on 65 foot radius curves and will permit pushing short trains of interurban trailers around such curves.

*	Adaptation of “Talgo Trucks” that will permit switching of standard railroad freight cars around 65 foot curves. This is not prototype but a handy method to include other freight cars in the switching operation.

*	Wire frogs with a point that will steer an incorrectly raked pole through the frog.

*	Miscellaneous topics that will include trolley shoe shape to make backing the pole easier, car weight, use of guard rails, lubrication of couplers and axles, and keeping wheel treads clean.

Typical minimum radii for various class of rolling stock for interurban pikes. From NMRA Recommended Practice RP 11 August 1970 by Hill, Hazen, Bradley.

Motive power and trail cars	**Minimum Radii**		
	Prototype	O	HO
All interurban equipment operating on street trackage coupled with radial couplers	50	12.5"	7"
Interurban motors and trailers to 40 with radial couplers	65	16”	9"
Interurban motors and trailers to 50' long with radial couplers	78	19.5"	11"
Interurban motors and trailers to 64' long with radial couplers. Standard railroad freight cars to 40' long with special couplers or adapters	100'	25"	14"
Two truck electric locomotives to 50' long and standard railroad freight cars to 50' long with regular couplers	118'	30"	16.5"
Two truck electric locomotives to 60' long and all standard railroad freight cars with standard couplers	146'	36.5"	20"

Note: The prototype CERA interurban freight trailer was designed to go around 35' radius curves (HO 4.8" radius, 0 8.75" radius). The actual working minimum radius for the prototype is currently unknown but I would guess about 50'. The absolute minimum radius was dictated by the truck wheel centers on the freight equipment.

The methods of this clinic have only been tested on an HO minimum radius of 9" (65' radius). It is likely the cars can be pulled around a 7" radius as long as the radial coupler bar does not hit the end of the coupler support. This has not been tried.

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AUTOMATIC RADIAL COUPLERS FOR TROLLEY FREIGHT SWITCHING

LINK BETWEEN COUPLER AND TRUCK THAT ALIGNS THE COUPLER

USE OF “TALGO” TYPE TRUCKS ON SOME FREIGHT EQUIPMENT

MODIFICATIONS OF KADEE COUPLER

COUPLER GUIDES

UNCOUPLING RAMPS

EXPECTATIONS FROM COUPLING SYSTEM

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Prototype Radial Coupler

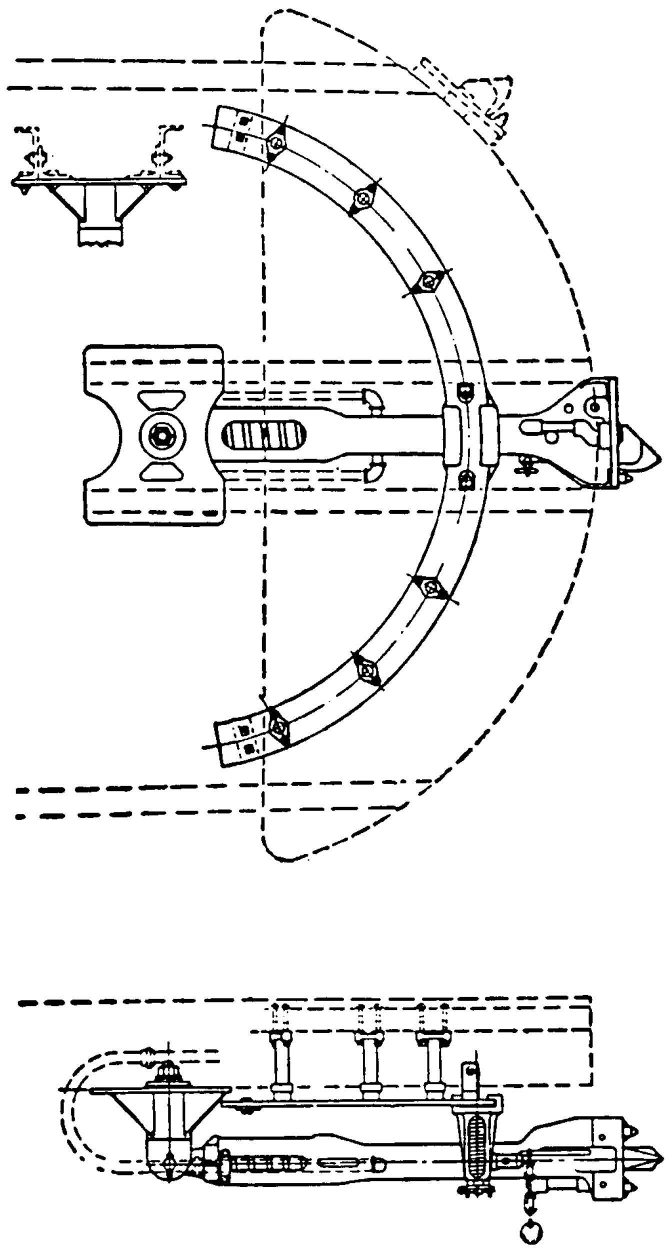
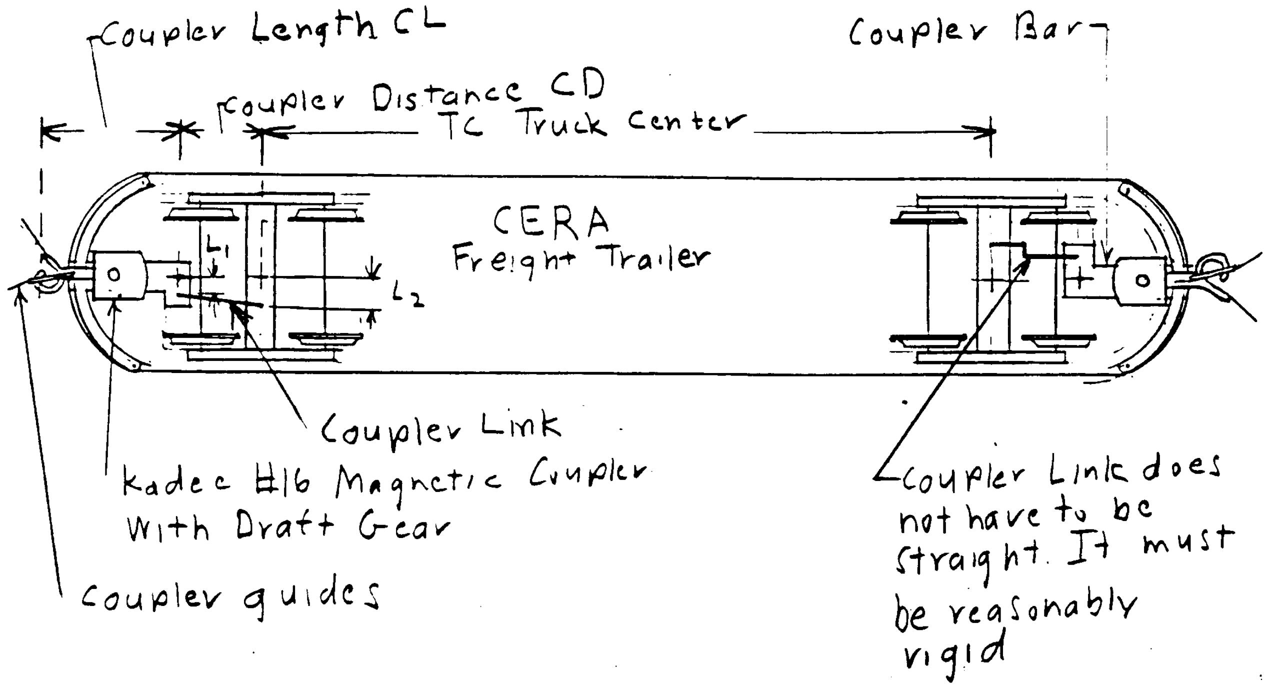
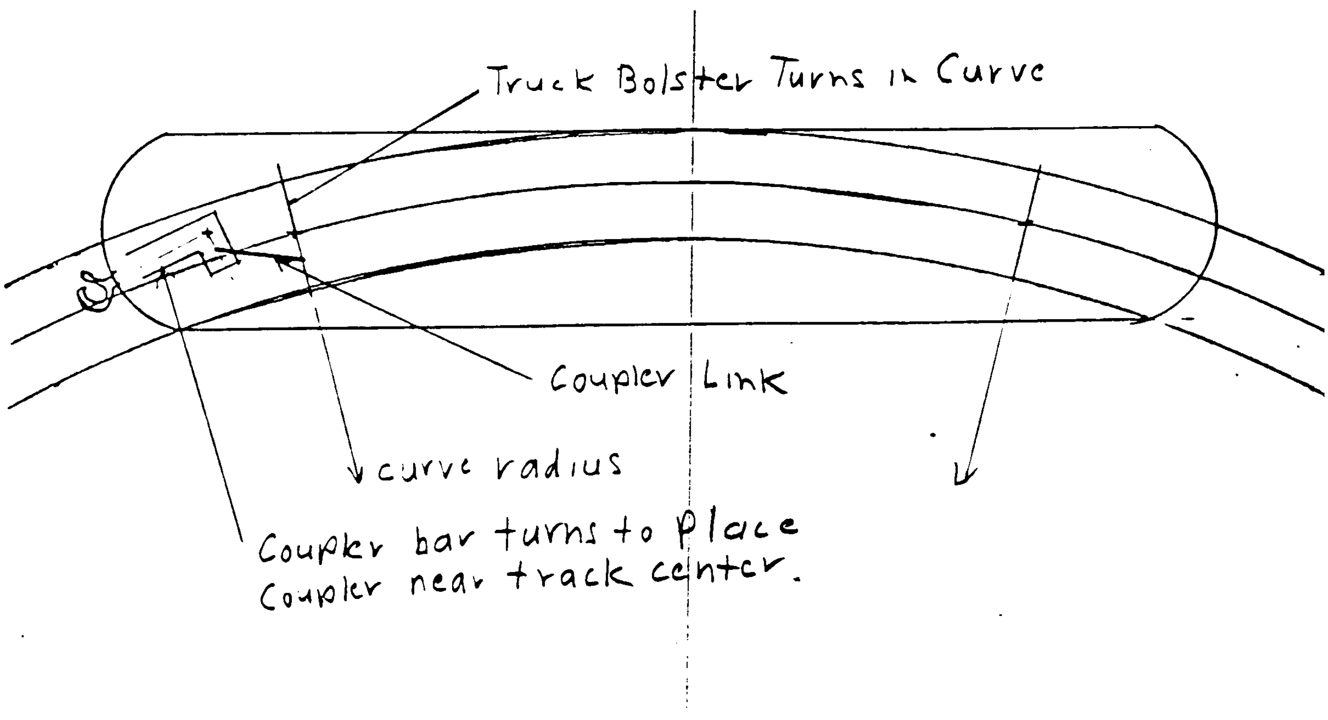


FIG. 32.—Typical coupler mounting on car.

From A. S. Richey Electric Railway Handbook

McGraw-Hill 1924





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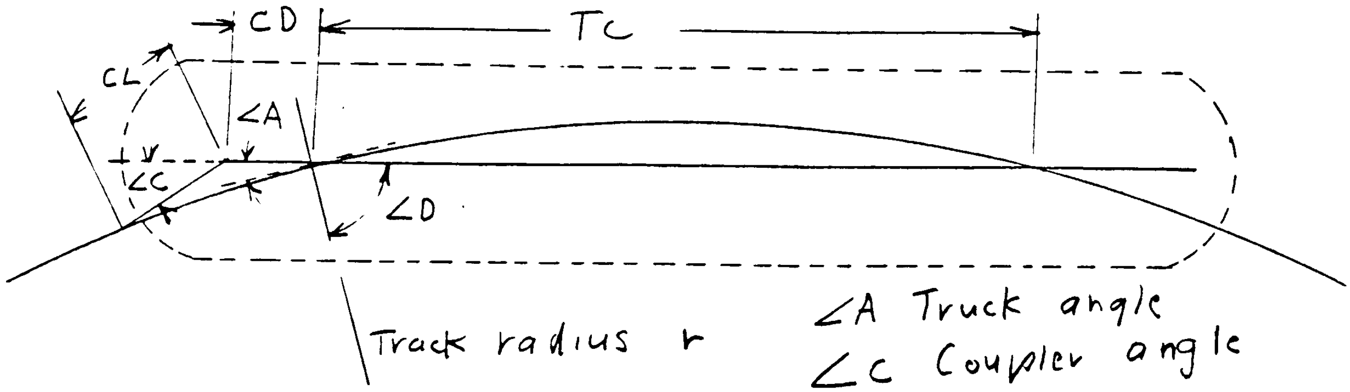

$\frac{\angle A}{\angle C} = \frac{L_1}{L_2}$ This is an approximation

Choose L_2 and calculate L_1 from $L_1 = \left(\frac{L_1}{L_2}\right) \times L_2$

Three Methods for Determining $\angle A$ and $\angle C$:

*** (1) Lay out scale drawing of car on minimum radius curve and measure $\angle A$ and $\angle C$ with protractor.

(2) Use trignometric equations: (Places coupler end at center of track)

$$\angle D = \arc\cos\left(\frac{TC}{2r}\right)$$

$$\angle B = \arc\sin\left(\frac{CD}{CL}\sin\angle A\right)$$

$$\frac{CL}{2r}\cos\angle B + \frac{CD}{2r}\cos\angle A + \cos(\angle A+\angle D) = 0$$

$$\angle C = \angle A+\angle B$$

These are transcendental equations solvable numerically with programmable calculator or computer.

** (3) Use graphs of L_1/L_2 and $\angle C$ as a function of CL and CD calculated from above equations.

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TWO GRAPHS REQUIRED TO SET UP COUPLER LINKAGE

LUCKY BREAK!

L_1 / L_2 calculations do not depend upon r (Track Radius) thus the graph for r = 65' will give the correct answer for r = 75', 100' etc.

L_1 / L_2 calculations do not depend upon TC (Truck Centers) for Truck Centers between 20-40'

This means the graph for L_1 / L_2 need only be done for one r value. Likewise the graph for TC = 30' will work for TC = 20' to 40'.

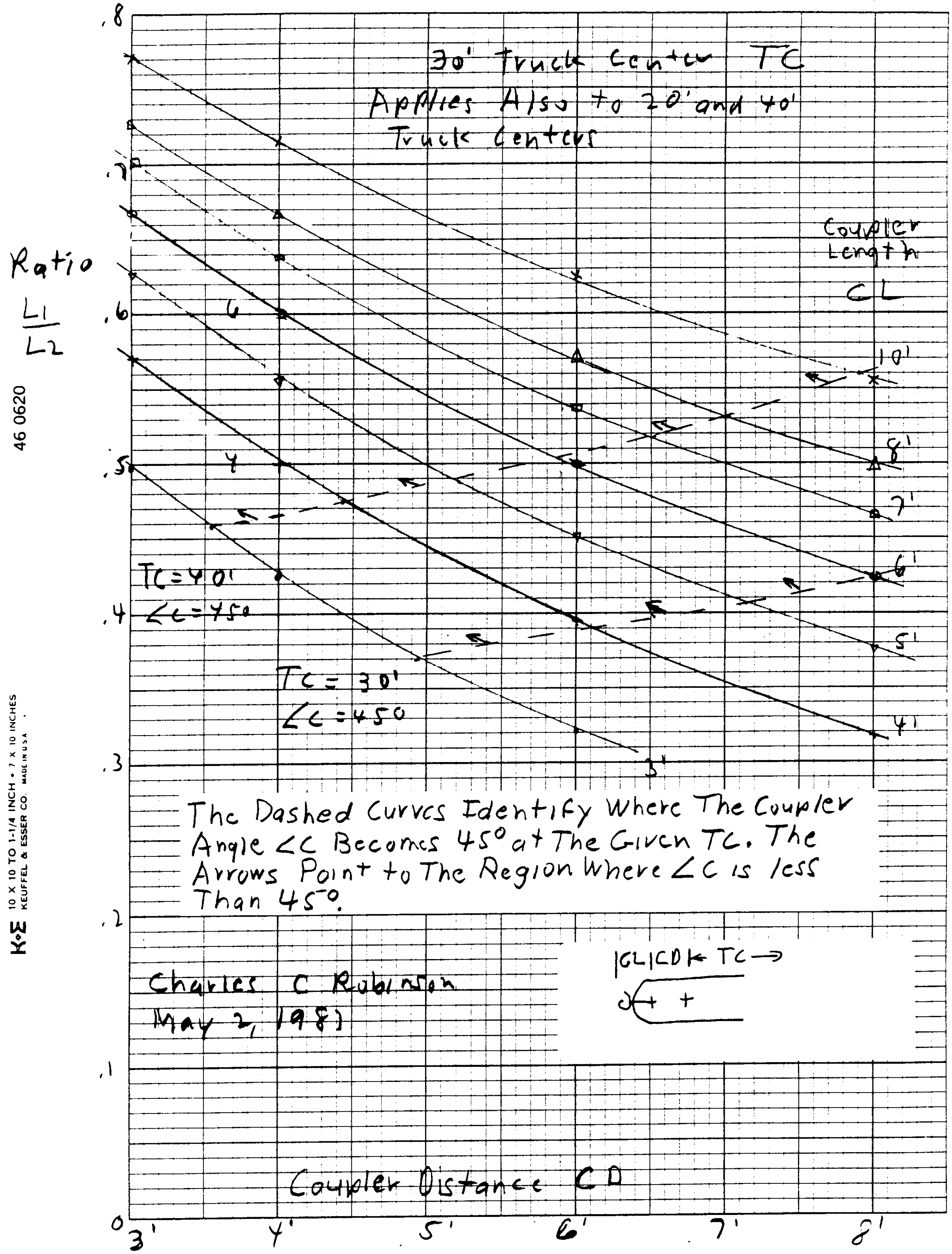
Graph I Calculates L_1 / L_2 from the value of Coupler Distance CD and from the value of Coupler Length CL.

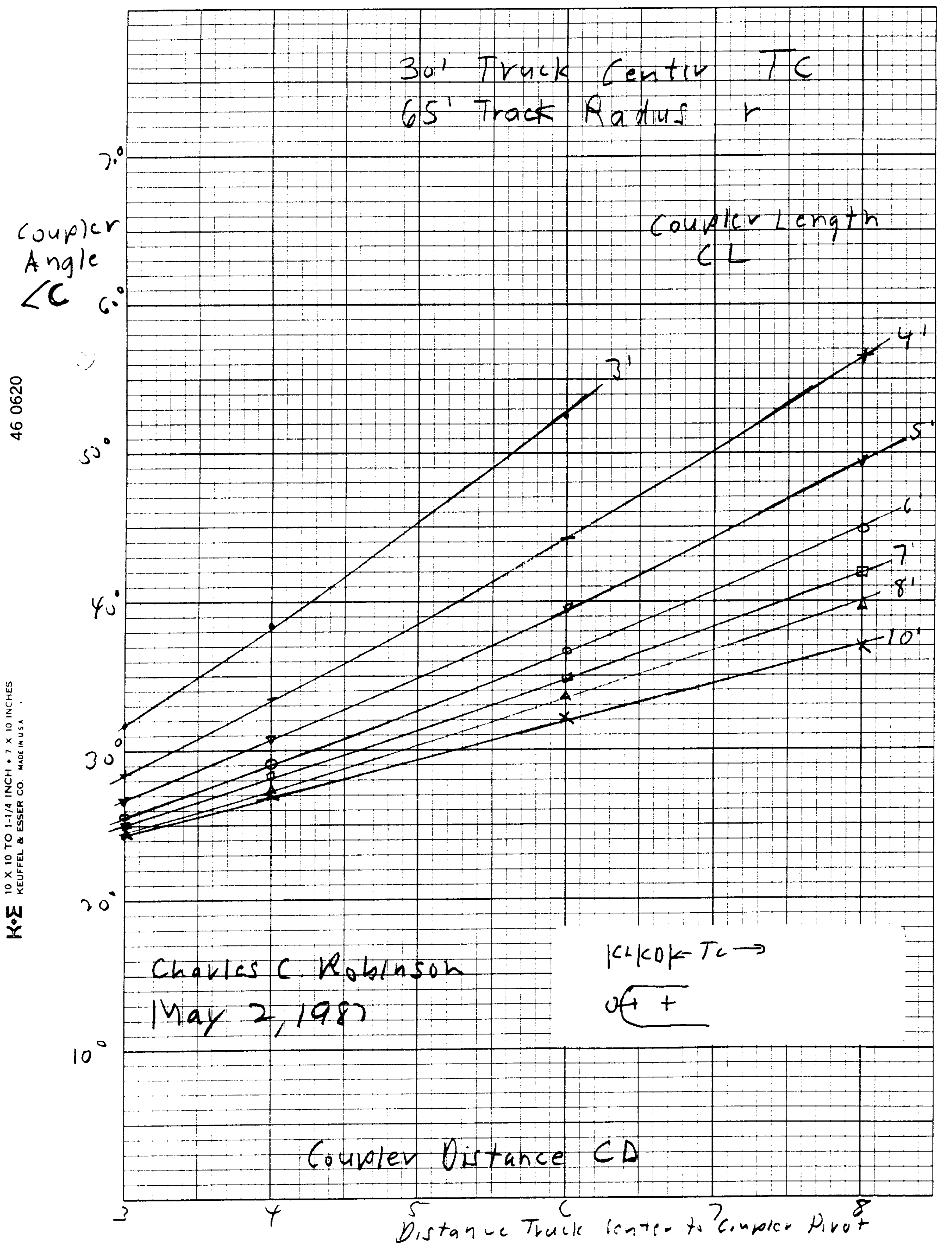
Use graph for r = 65' and Truck Center TC = 30' (Works for TC = 20' to 40')

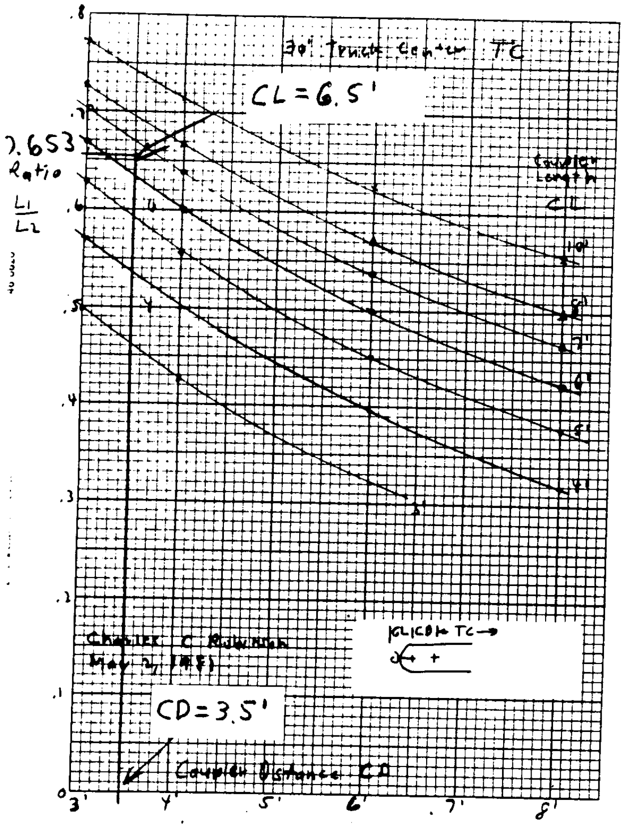
Graph II Calculates maximum Coupler Angle for smallest radius 65'

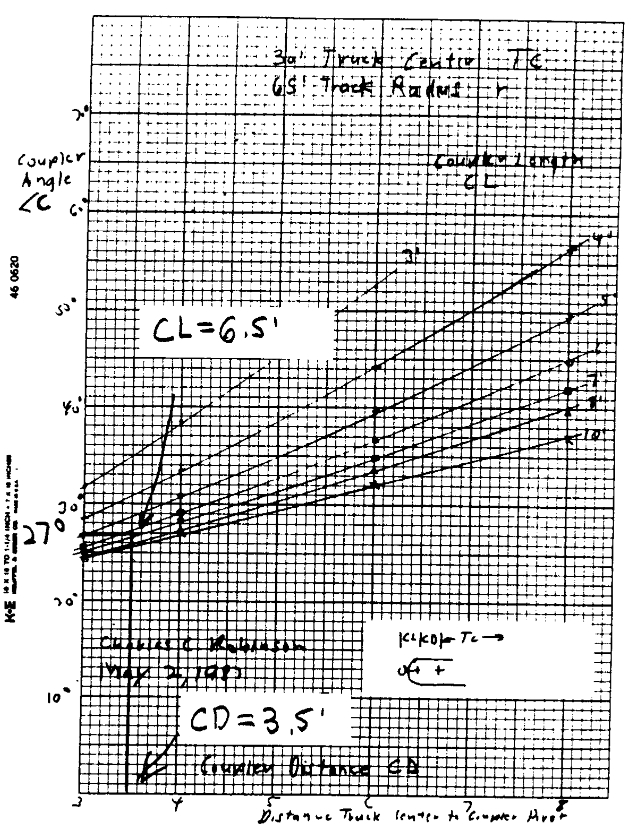
Use graphs for 65' radius and for Truck Centers that bracket the Truck Center value for the car. Interpolate the maximum Coupler Angle between the results of these two graphs. See coupler angle graphs for TC = 20' and 40' in appendix for the other graDh used to interpolate the coupler angle for the following examples.

Maximum Coupler Angle should in general be less than 450 to prevent the coupler from hitting the ends of the coupler support.


30' Truck Center TC
Applies Also to 20' and 40' Truck Centers
Coupler Length CL
Ratio
L1/L2
.8
.7
.6
.5
.4
.3
.2
.1
0
10'
8'
7'
6'
5'
4'
3'
6
4
TC = 40'
∠C = 45°
TC = 30'
∠C = 45°
The Dashed Curves Identify Where The Coupler Angle ∠C Becomes 45° at The Given TC. The Arrows Point to The Region Where ∠C is less Than 45°.
|CL|CD|← TC →
Charles C Robinson
May 2, 1987
Coupler Distance CD
3'
4'
5'
6'
7'
8'
46 0620
K+E 10 X 10 TO 1-1/4 INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.


30' Truck Center TC
65' Track Radius r
Coupler Angle ∠C
Coupler Length CL
3'
4'
5'
6'
7'
8'
10'
70°
60°
50°
40°
30°
20°
10°
Charles C. Robinson
May 2, 1987
Coupler Distance CD
3
4
5
6
7
8
Distance Truck Center to Coupler Pivot
46 0620
K+E 10 X 10 TO 1-1/4 INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN USA





Measurements for CERA trailer:

Calculate L_1/L_2 →
Truck Center TC = 32'
Coupler Distance CD = 3.5'
Coupler Length CL = 6.5'
From graph for 30' TC $L_1/L_2 = 0.65$

Check Maximum Coupler Angle →
From graph for 30' TC ∠C(30') = 27°
From graph for 40' TC ∠C(40') = 33.8° (Not shown)
Interpolating for TC = 32': 10' = TC40' - TC30' = 40'-30'

$$(C(40') - C(30')) \times \frac{(TC-30')}{10'} + \angle C(30') =$$

$$(33.8^{\circ}-27^{\circ}) \times \frac{(32'-30')}{10'} + 27^{\circ} = \underline{28.76^{\circ}} = \angle C(32')$$ COUPLER ANGLE OK

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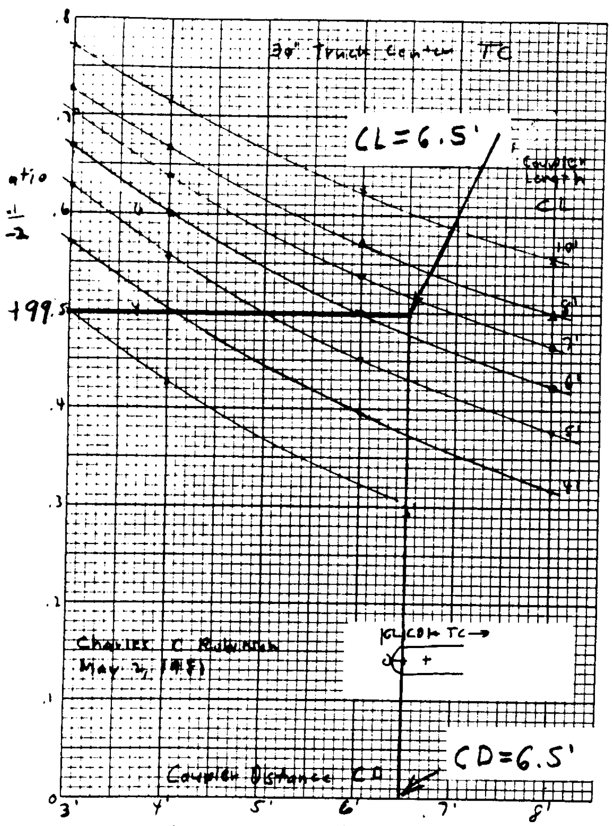

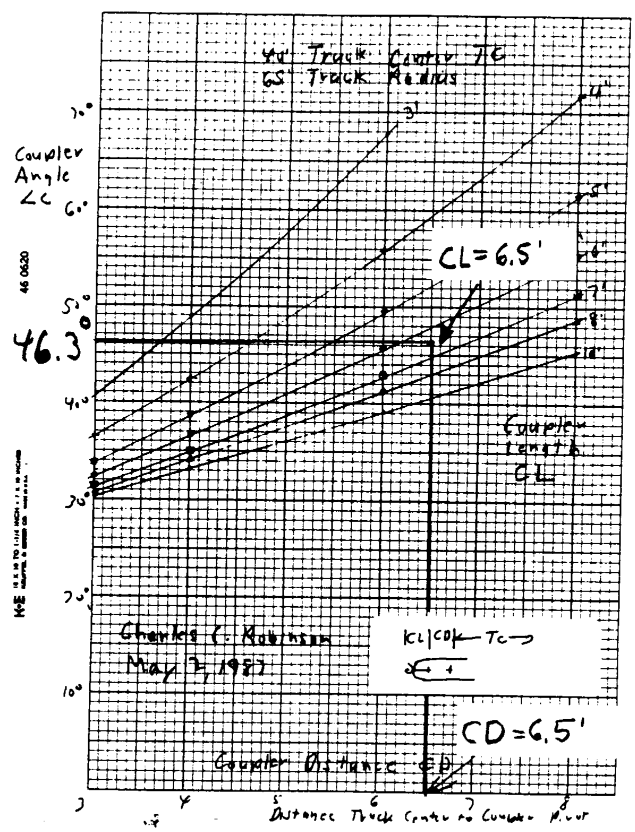

Measurements for 62' interurban passenger car:

Calculate L_1/L_2 →

- Truck Center TC = 38.5'
- Coupler Distance CD = 6.5'
- Coupler Length CL = 6.5'
- From graph for 30' TC $\underline{L_1/L_2 = 0.499}$

Check Maximum Coupler Angle →

- From graph for 30' TC $\angle C(30') = 37.5^0$ (Not shown)
- From graph for 40' TC $\angle C(40') = 46.3^0$
- Interpolating for TC = 32': 10' = TC40' - TC30' = 40'-30'

$$(C(40') - C(30')) \times \frac{(TC-30')}{10'} + \angle C(30') =$$

$$(46.3^0 - 37.5^0) \times \frac{(38.5' - 30')}{10'} + 37.5^0 = \underline{\underline{45^0}} = \angle C(38.5) \quad \text{OK}$$

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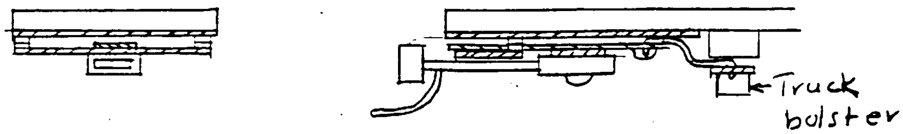
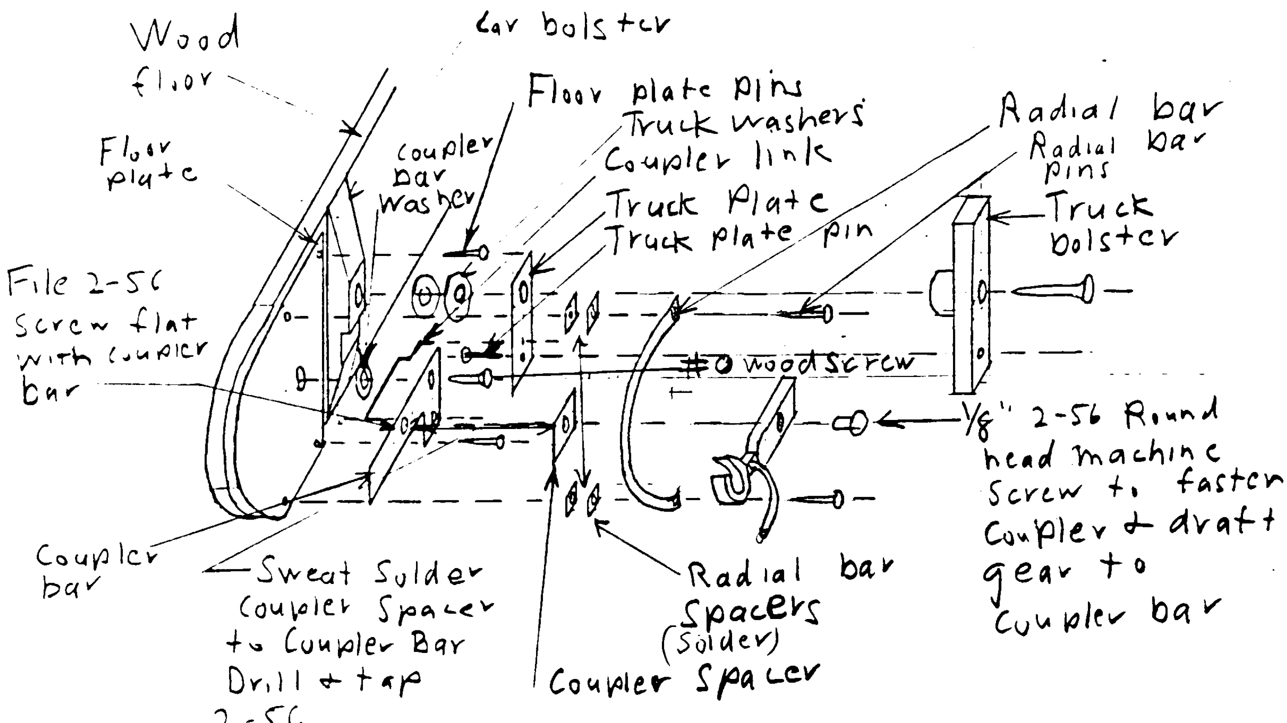
Radial Coupler Assembly



Coupler Link .020 Phosphorus Bronze Wire
Drill snug holes for link



All brass .016" shim stock except washers. Cut parts with jewelers saw to make flat
Smooth all edges with file. Feather sides of coupler bar where riding on radial bar

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