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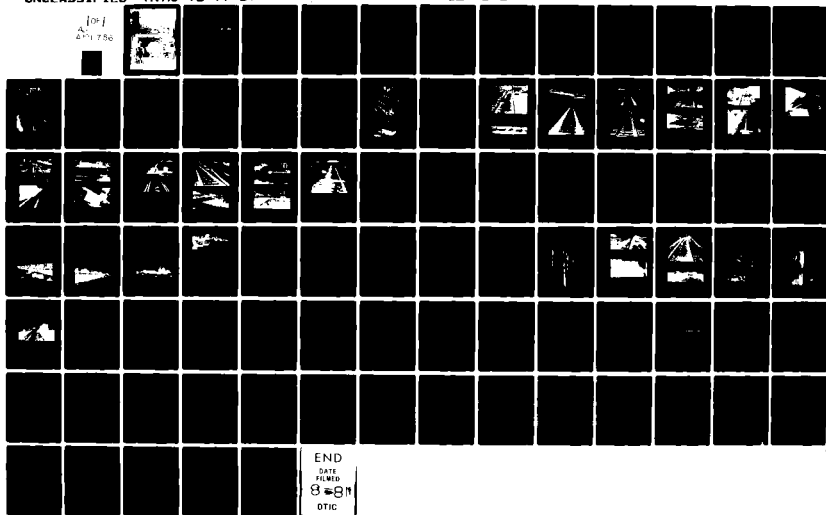
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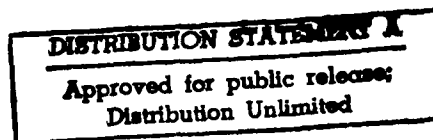


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MTMC REPORT TE 77-27
RAIL OUTLOADING CAPABILITY STUDY
FORT CARSON, COLORADO

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EXECUTIVE SUMMARY

1. SCOPE

At the request of the Deputy Chief of Staff for Logistics, Department of the Army Headquarters, the Military Traffic Management Command (MTMC) conducted a field survey of the rail facilities at Fort Carson, Colorado, to determine the station's outloading capability. The field survey was conducted 10 through 14 January 1977. Rail facilities within 25 miles of the installation were included in the survey.

2. FINDINGS

The primary finding at Fort Carson was that its rail system outloading capability can support relatively large-scale operations, provided all trackage at Kelker yards is used to classify incoming empty railcars. Kelker yards are owned by the Atchison, Topeka and Santa Fe (ATSF) Railroad and by the Denver and Rio Grande Western (DRGW) Railroad, and are used for interchange of railcars between the two railroads and Fort Carson. The condition of the railroad tracks at Fort Carson is generally good; all trackage is usable, but some maintenance, including new end-loading ramps, is required. A significant supply of blocking and bracing materials is on hand, but outloading plans have not been prepared and the supply of small hand tools is inadequate. If outloading plans and small hand tools were available and the Kelker yards were used for classification, current capability would be 105 railcars per day. Fort Carson is more than 600 miles from the nearest port of embarkation (POE); therefore all equipment must be moved by rail. A total of 1,770 railcars are required to transport the division equipment, and a high daily outloading rate (more than 105) is necessary. Since no outloading plans were available, the analysis was based on outloading rates that would produce 1,770 railcar loads in 7 days. Because of the size and configuration of the rail system, the maximum outloading rate that can be achieved, using all existing trackage, is 260 railcars per 24-hour day, as determined by our analysis. At this rate the division equipment could be outloaded in 7 days. Other options producing from 154 to 207 railcars per day were considered and are presented in this report.

Division representatives of the ATSF and DRGW Railroads assisted in determining the extent and capability of their facilities within 25 miles of Fort Carson. A proposed outloading plan, which envisions stationing a locomotive at Kelker yards, was generally agreed to be feasible. A survey of the area revealed that adequate trackage is available for

storage of railcars to support outloading operations, and that two small "piggyback" ramps in Colorado Springs, one owned by each railroad, could be used for small-scale operations.

3. CONCLUSIONS

- a. The condition of the railroad tracks at Fort Carson is generally good and all tracks are usable; however, some maintenance, including ramp construction, is required. Current rail outloading capability is limited also by lack of necessary supporting elements, such as outloading plans and small hand tools.
- b. Because of Fort Carson's location, more than 600 miles from all POEs, all equipment would have to be outloaded by rail. Necessary supplies should be stocked accordingly.
- c. Estimated minimal cost for upgrading the rail system to improve operating efficiency, insure a continued effective system, and achieve an outloading rate of 260 railcars per 24-hour day is \$189,250. At this rate, after receipt of sufficient railcars to permit full-scale operations, the division equipment could be outloaded by rail in 7 days.
- d. Physical improvements to the rail system and other additions for outloading (sec II, para D4) should be implemented to insure effective outloading operations.
- e. The Kelker yards near Fort Carson should be used to classify incoming empty railcars destined for Fort Carson, as to type, length, height, and position in string, before movement onto the installation.
- f. Adequate railcar storage capacity to support a volume outloading of Fort Carson's units exists within 25 miles of Fort Carson.
- g. Rail trackage outside of but in the vicinity of Fort Carson is in fair to good condition.
- h. The ATSF and DRGW representatives did not express any reservations regarding the outloading of Fort Carson units concurrently with other commercial demands.
- i. Fort Carson transportation personnel should coordinate planning of impending outloading operations with the ATSF and DRGW representatives at the earliest possible date.

- j. Because of the small amount of trackage at Fort Carson, any track removed as a result of future construction should be replaced by a similar track in an appropriate area.
- k. Since only one set of scales is available, equipment weighing should begin several days before outloading.
- l. The analysis of existing rail trackage at Fort Carson and Kelker indicates that one main line locomotive and two switching engines will be required, for moving trains and shifting empty cars, to produce an output of 260 railcars per 24-hour day. These are in addition to the locomotive power required to pick up three loaded trains per day.
- m. For administrative-type moves, for which lead time is plentiful and costs must be considered, special-purpose railcars, such as bilevel autoracks, trailer-on-flatcar (TOFC), and container-on-flatcar (COFC) cars, which are more cost effective than the standard types, should be used.
- n. For mobilization moves, when time is more critical than costs, the use of special-purpose railcars may not be possible because of the short lead time and the relatively short supply of cars in high demand.
- o. For the REFORGER move, bilevel railcars could be loaded on track 8. Since the timber end ramp is structurally unsound, it could be removed and a portable ramp could be obtained from the ATSF Railroad. This would permit 20 bilevel car loadings per day. If not, track 3 could be used to load 12 bilevel cars per day.
- p. The 44 USAX nonroadable boxcars on track 8 that are used for supply storage eliminate the use of one outloading site; consequently, other arrangements should be made to store the supplies, and the cars should be designated as surplus.

4. RECOMMENDATIONS

- a. Undertake those items listed in section II, paragraph D4, "Physical Improvements and Additions." These improvements will provide a rail system capability of 260 railcars per day and will insure a continued effective rail system.
- b. Prepare a detailed unit outloading plan, using the simulation in Appendix B as an example, that specifies unit assignments at loadout sites and movement functions.

- c. Coordinate rail outloading plans with the ATSF and DRGW Railroads at the earliest possible date.
- d. Continue rail facility maintenance to insure an effective rail system.
- e. Provide advance training for blocking and bracing crews.
- f. Station a switching engine(s) at Kelker yards and use it to classify incoming empty railcars.
- g. Station road guards at all railroad crossings during train movements and provide all train crewmen with walkie-talkies to insure a more safe and efficient operation.
- h. Replace all track removed due to future facilities construction with a like amount in an appropriate location.
- i. Keep abreast of the ATSF and DRGW Railroad plans for maintenance and/or removal of the trackage at Kelker yards, as this trackage is essential for the support of major outloading operations.
- j. Arrange with the ATSF and/or the DRGW Railroad(s) for the services of one main line locomotive and one switching engine to work with the Government locomotive, at Kelker yards and Fort Carson, to insure an outloading production rate of 260 railcars per day. These are in addition to the locomotive power required to pick up three loaded trains per day during the operation.
- k. Begin weighing equipment to be outloaded several days before outloading begins.
- l. Use special-purpose railcars, such as bilevel autoracks for small vehicles, TOFC cars for semitrailers and vans, and COFC cars for MILVANS, for administrative-type moves and, as available, for mobilization moves.
- m. Load bilevel railcars on track 8 (20 per day). Remove deteriorated timber end ramp, and obtain a portable ramp from the ATSF railroad for the move; alternate plan could use track 3 (12 per day).
- n. Provide warehousing for the supplies that are stored in the 44 USAX nonroadable boxcars on track 8, and designate boxcars as surplus.

I. INTRODUCTION

The Deputy Chief of Staff for Logistics requested that MTMC conduct deployment studies of four Army divisions; Fort Carson, whose main entrance is on US Highway 85 approximately 3 miles south of Colorado Springs, Colorado (Figure 1), was one of the four. This report covers the rail outloading phase of the deployment. The principal objective of the study was to determine Fort Carson's ability to support the deployment of the 4th Infantry Division. The study was to include also any physical improvements that could significantly increase present capabilities, as well as consideration of commercial facilities within 25 miles of Fort Carson.

To fulfill this request, an onsite survey was conducted at Fort Carson 10 through 14 January 1977. The major findings of the survey and the ensuing analysis are that the existing rail trackage and facilities will support a maximum outloading rate of approximately 105 flatcars per 24-hour day. However, Fort Carson's outloading capabilities are restricted by lack of outloading plans, materials, and other necessary elements. Physical improvements, such as track maintenance and end-ramp construction, along with other necessary elements, could establish an outloading capability up to 260 railcar loads per 24-hour day. Commercial rail facilities within 25 miles of Fort Carson were found to be in generally fair to good condition. Two "piggyback" ramps in Colorado Springs could be used for small-scale operations, but no volume outloading facilities are available.

Findings and recommendations contained in this report are based on analysis of data obtained during the field study and other pertinent information relating to installation activities at that time. Problems incurred during implementation of the recommendations should be referred to MTMC TEA for resolution.

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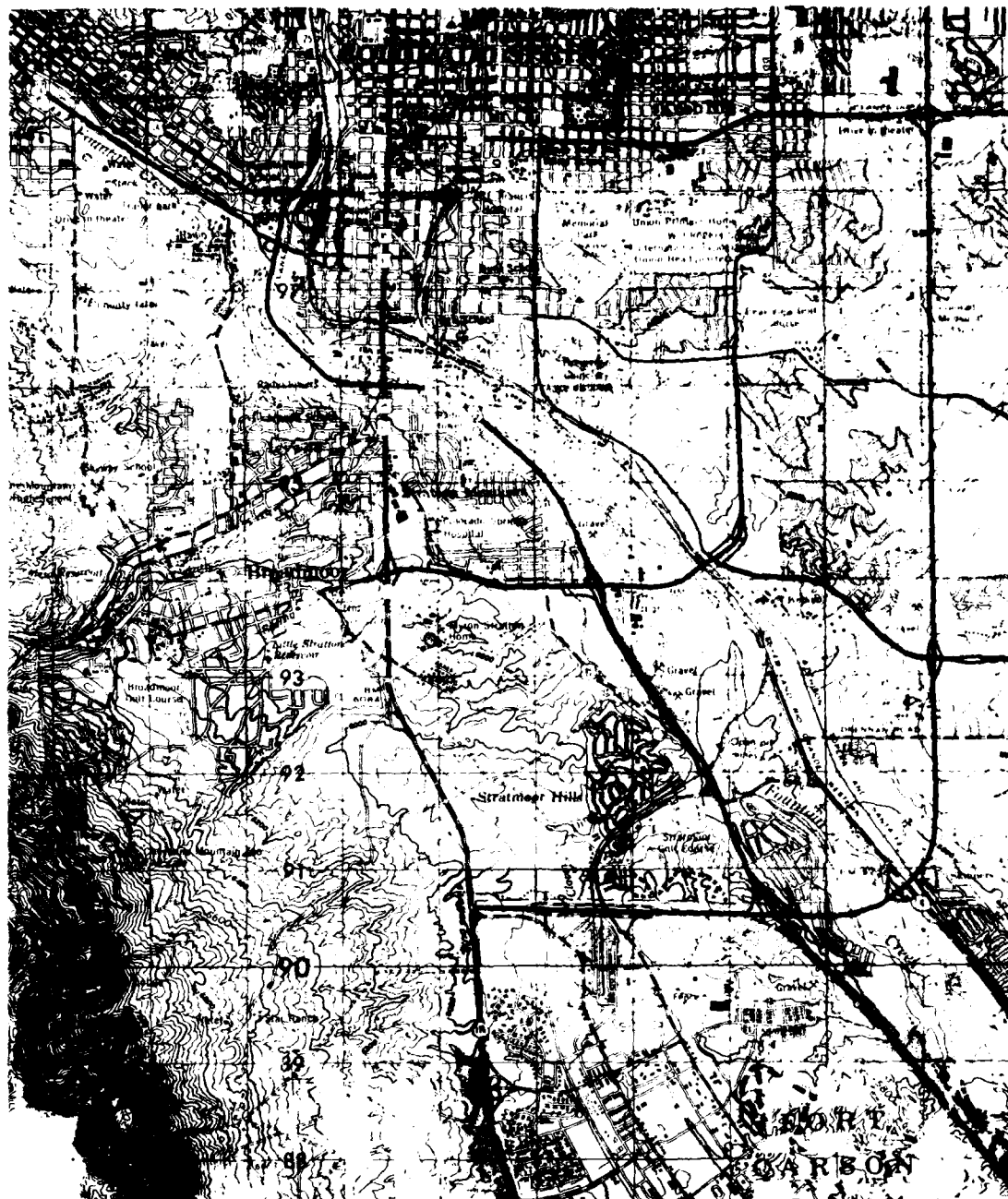


Figure 1. Fort Carson and Vicinity.

II. ANALYSIS OF FORT CARSON'S RAIL OUTLOADING FACILITIES

A. GENERAL

Discussions with personnel of the Transportation Office and the 4th Division at Fort Carson, and with officials of the ATSF and DRGW Railroads concerning rail outloading revealed that large-scale rail operations have occurred at the post in recent years. Factual data about locomotive operating times and switching operations were obtained from the installation's rail crew, which operates the Government-owned 120-ton locomotive. Loading, blocking and bracing, and inspection times were obtained from an actual field test, during REFORGER 76.

B. RAIL FACILITY DESCRIPTION

Fort Carson's rail system is illustrated in Figures 2 and 3 and described in Table I. The survey of all sites that possibly could be used for outloading equipment revealed that seven sites are currently usable for end-loading vehicles, and that four other sites have potential but currently are either unusable or deficient as noted in Table I. The following discussion begins with the westernmost tracks on the installation, where the post main line enters and proceeds east through the installation.

Tracks 1 and 2 are in good condition. Both are lighted and have concrete end-loading ramps and large staging areas; these are the best outloading sites on post, Figures 4 through 6.

Tracks 3, 4, and 12 form a "Y." The west leg of the "Y," track 3, has potential as a loading site if equipped with an end-loading ramp. Also lighting and some surfacing would be required for a staging area, Figures 7 and 8.

Track 4, the east leg of the "Y," is in good condition, has an end-loading ramp, and is lighted; but access to the ramp is congested, and staging of vehicles for loading at the ramp would have to be done in the street.

Track 5 is used for most incoming supplies shipped by rail. This track is in good condition, has a concrete end-loading ramp, and is lighted; however, as is the case with track 4, access to the ramp is poor and staging for vehicles would have to be done in nearby streets, Figures 9 through 11.

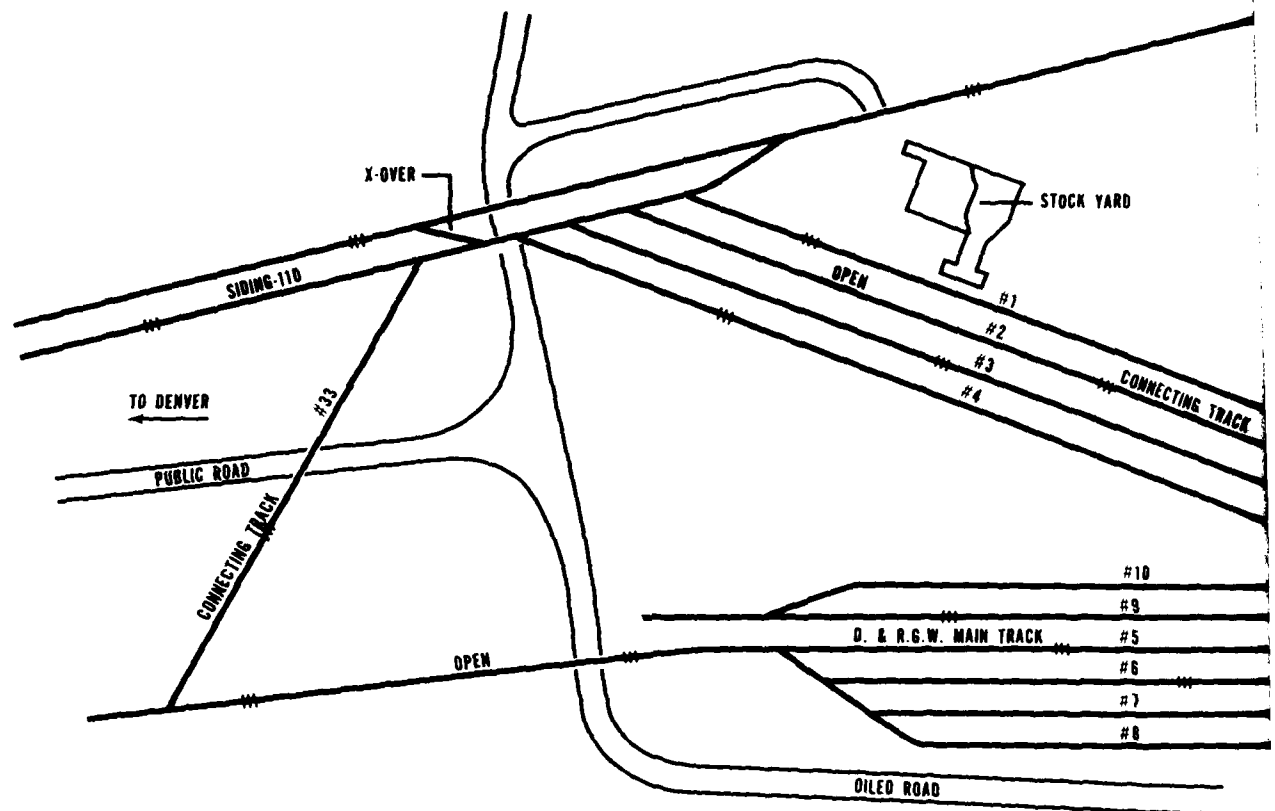
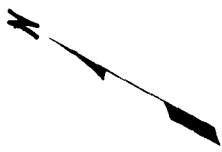


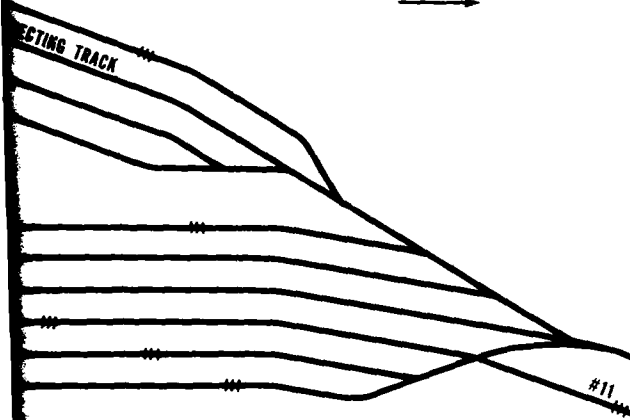
Figure 2. Fort Carson Rail System and Kelker Interchange Yard.

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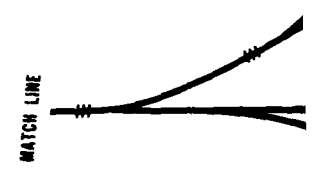
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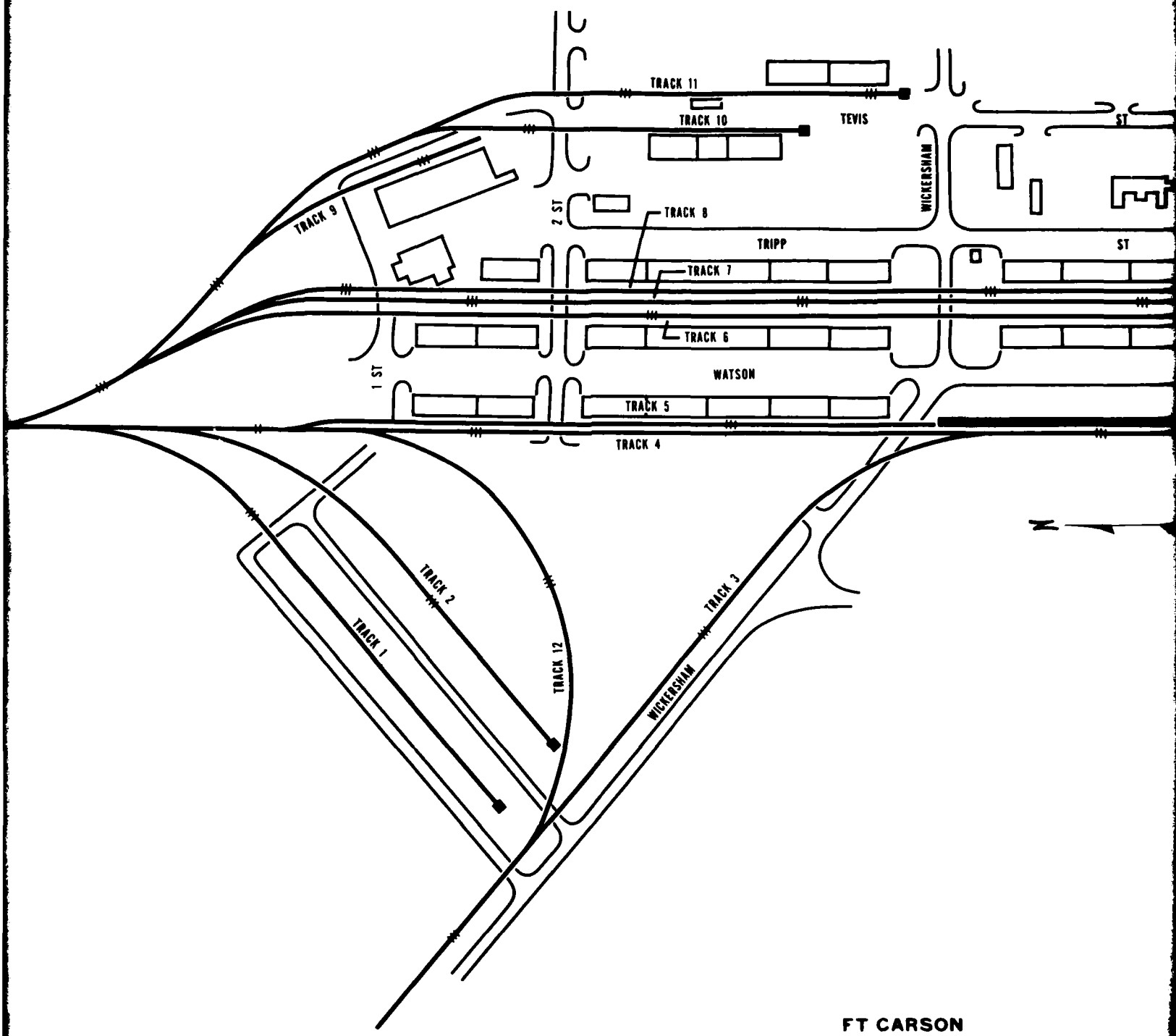
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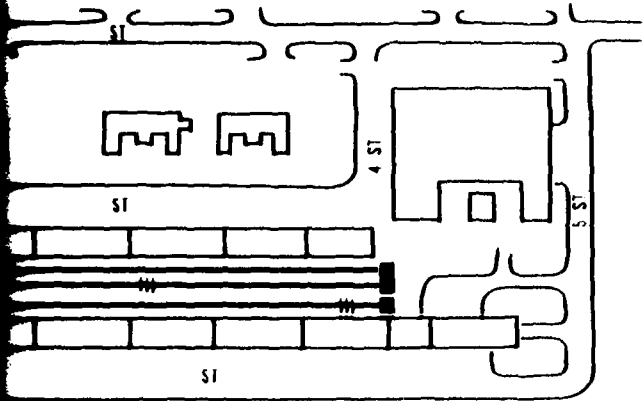
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MATCH LINE



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FT CARSON



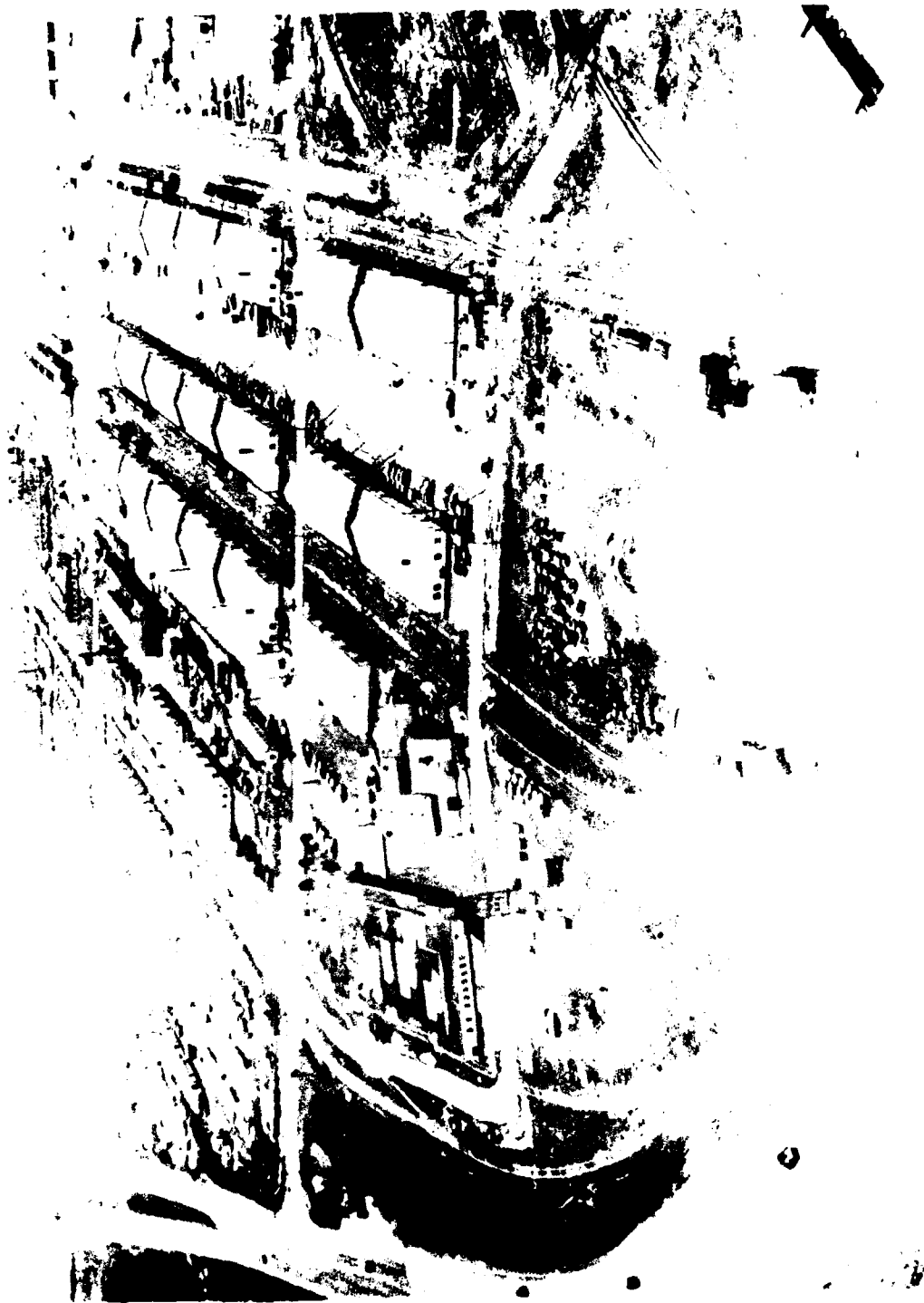


Figure 3. Aerial View of Fort Carson's Rail System (Looking South).

TABLE I
RAILROAD OUTLOADING FACILITIES ON THE INSTALLATION

Track and Figure Number	End Ramp	Lighting	Surface Conditions	Staging Area	Railcar Capacity (60-Foot Lengths Straight Track) ^{a/}	Access Availability	Present Condition of Track ^{b/}
1 (Fig 4 and 5)	Yes Concrete	Yes	Good, graveled	Adequate, no other function in area	20	Good	Good
2 (Fig 6)	Yes Concrete	Yes	Good, graveled	Adequate, no other function in area	16	Good	Good
3 (Fig 7 and 8)	No	No	Natural ground, adjacent to track.	Adequate, but not surfaced	20	Good	Good
4 (Fig 9-11)	Yes Yes Concrete	Yes Yes	Good, graveled	None, will have to use streets	31 22	Poor Poor at Ramp	Good Good
6 (Fig 12-14)	Yes Concrete	Yes	Good, graveled	Adequate alongside of track.	40	Good	Fair--Usable Perforated culvert required along west side of track for drainage to improve track stability. Some ties and plates need to be replaced.
7 8 (Fig 15-18)	Yes Both wood, unusable should be replaced.	Yes Yes	Good graveled (both)	None, would have to use street. (Both)	40 33	Good Good	Usable--But both tracks need aligning and surfacing.
9 (Fig 19)	No	No	Good graveled	None, would have to use street	9	Good	Good--But mostly covered at cold storage warehouses. Some drainage work required.
10 11 (Fig 20-23)	Yes Both concrete	Yes Yes	Good, both graveled or paved	Some room alongside tracks, but would also have to use streets	14 15	Good	Fair--Usable 10 Require spot tie replacement. 11 need drainage improvement.
Total					260		

^{a/} Coupler to coupler length 60 feet.

^{b/} See Appendix A; see also Federal Railroad Administration, Title 49, Part 213, Track Safety Standards.



Figure 4. Entrance to Track 1.

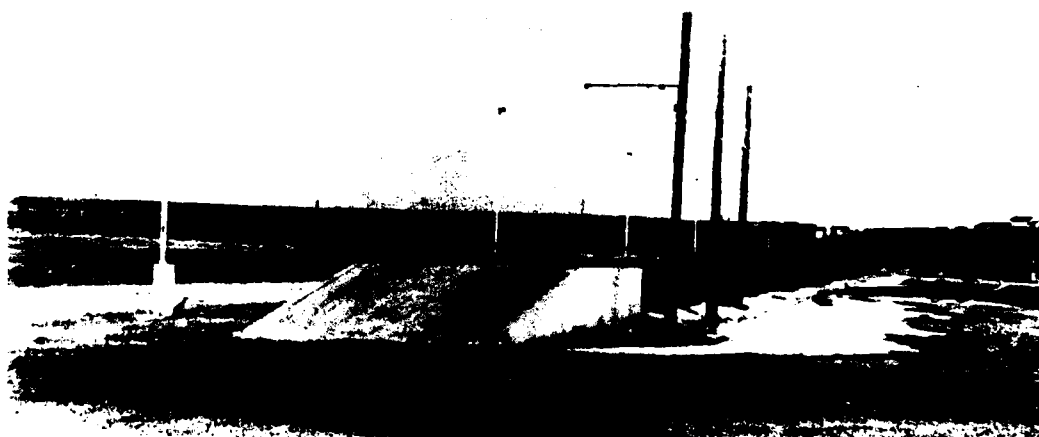


Figure 5. Concrete End-Loading Ramp, Track 1.

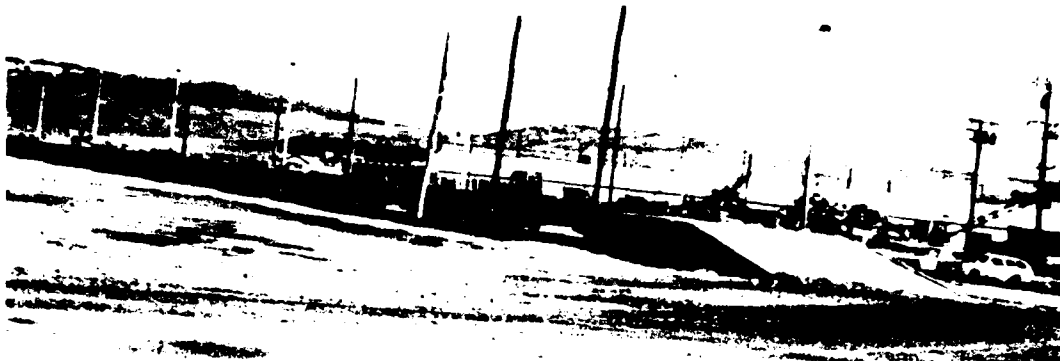


Figure 6. Concrete End-Loading Ramp, Track 2.



Figure 7. West Leg of "Y," Track 3.



Figure 8. Spur 3 (Looking South).



Figure 9. Tracks 4 and 5 (Looking South), Track 5 on Left.



Figure 10. Tracks 4 and 5 Near South End.



Figure 11. Concrete End-Loading Ramp, Tracks 4 and 5.

Track 6 is in fair, usable condition; however, the drainage ditch along most of the west side should be equipped with a perforated culvert to prevent undermining of the ballast, and a number of ties and plates should be replaced. This track has a concrete end-loading ramp, lighting, fair access, and some staging area, Figures 12 through 14.



Figure 12. North End of Track 6.



Figure 13. Ditch/Ballast Along Track 6, Which Requires Maintenance.

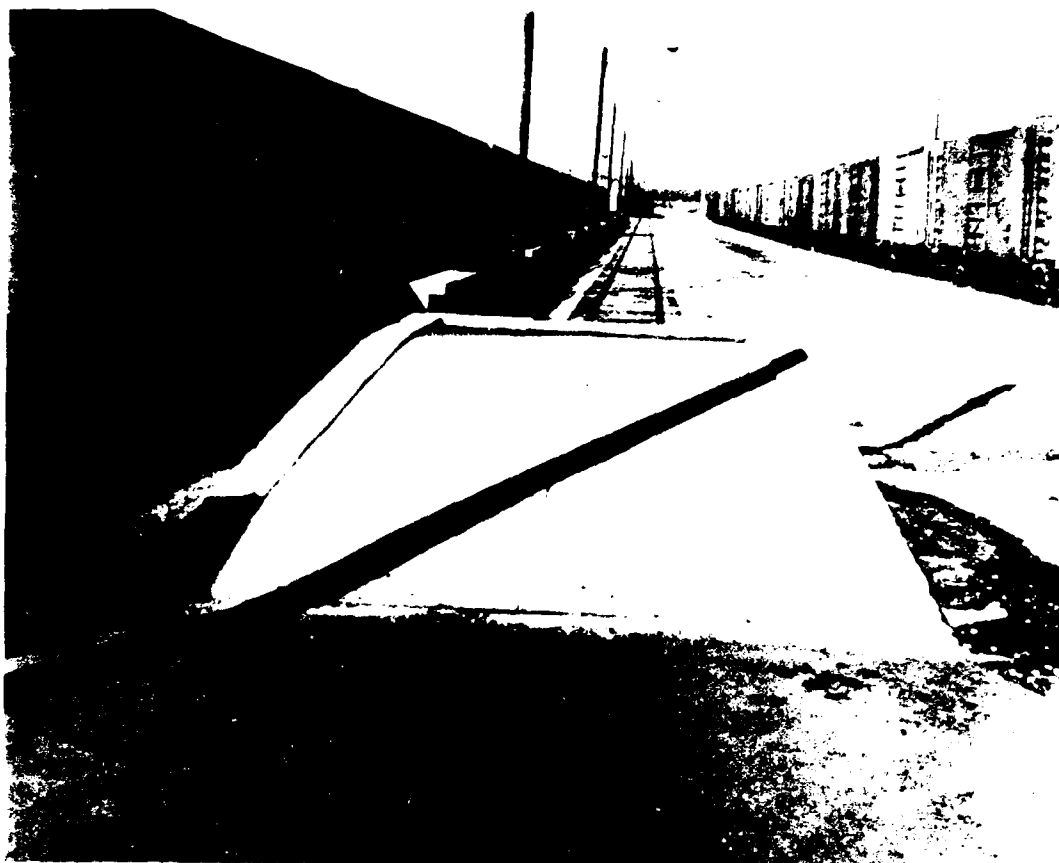


Figure 14. Concrete End-Loading Ramp, Track 6.

Tracks 7 and 8 are usable, lighted, and surfaces and access are good; however, staging would have to be done in local streets, both tracks need surfacing and aligning, and both of the timber end ramps should be replaced because of age and questionable structural strength, Figures 15 through 18.

Track 9 is used for rail delivery of frozen foods to the cold storage warehouse. Although its surface is good, it has no end ramp nor lighting, and staging to load vehicles would have to be done in local streets. Access to track 9 is good, and the track itself appears to be in good condition but some of it is covered by pavement and gravel. Some drainage work is required near the north end, Figure 19.

Tracks 10 and 11 are equipped with concrete end-loading ramps, are lighted, and have good access and surface; however, staging of vehicles for loading would have to be done along city streets. Track 10 requires spot tie replacement, and track 11 needs drainage improvements, Figures 20 through 23.



Figure 15. North End of Tracks 7 and 8, Track 8 on Left.



Figure 16. Tracks 7 and 8 Require Alignment and Surfacing, Track 8 on Right.



Figure 17. Old Timber Ramps at Tracks 7 and 8.



Figure 18. Rotten Sill Supporting Timber Ramp.



Figure 19. Track 9 at the Cold Storage Warehouse (Looking South).

The north end of tracks 9 and 10 could be used to load CONEX containers, which are usually loaded into gondolas by crane. Track 9 is shown in Figure 24. Track 10 is similar to track 9.

The installation's main line track is in generally good condition and is usable its entire length. The worst deficiencies are settlement of the bed in several places and deteriorated ties. The ties should be replaced and some ballast added to correct low sections of track. The rail system is in generally usable condition; however, all of the above deficiencies, which can be remedied for \$189,250, should be corrected to conform to class 2 for main line track and to class 1 for



Figure 20. North End of Tracks 10 and 11.



Figure 21. Concrete Ramps at Tracks 10 and 11 (Looking North).



Figure 22. Concrete Ramp at Track 11 (Looking North).



Figure 23. Approach to Ramps at Tracks 10 and 11.



Figure 24. North Portion of Curved Track 9, Could be Used to Load CONEX Containers.

all other track of the track safety standards, Appendix A, as a minimum.^{1/} Correction of the deficiencies will improve operating speeds, preclude possible derailments, and insure a continued effective rail system.

Access to Fort Carson's rail system is good. Vehicles from motor pools and equipment from storage areas can be routed along good asphalt roads to any of the loadout sites. This fact, coupled with the potential of the rail system, indicates that Fort Carson can develop sufficient capability to successfully outload the division within an acceptable time frame.

^{1/} Federal Railway Administration, Title 49, Part 213, Track Safety Standards.

C. CURRENT PROCEDURES

Both the ATSF and DRGW Railroads serve Fort Carson and each has a small interchange yard at Kelker, 2.2 miles by the installation main line track to the Fort Carson rail system. Installation pickup and delivery of railcars is performed by the Fort Carson rail crew, using a Government-owned 120-ton locomotive, operating between Kelker and the installation. Most incoming supplies are delivered by truck; however, rail operations average about 38 railcars per month. Due to inadequate warehouse facilities, 44 USAX boxcars are used for supply storage. These boxcars are nonroadable and their occupation of track space will hamper outloading operations. Outloading plans have not been developed by Fort Carson personnel as yet; however, unit blocking and bracing crews receive periodic training, and blocking and bracing materials are available for two brigades. Some, but not enough, hand tools and bridge plates are available. Preparations for outloading the entire division within a 7-day period should be pursued until acceptable plans and arrangements have been completed.

D. RAIL SYSTEM ANALYSIS

1. Current Outloading Capability

Fort Carson's rail system has a much greater potential capability than current capability, due primarily to present operating practices. Detailed systems analyses have shown that, in order to realize even the current maximum capability, the ATSF and DRGW interchange trackage at Kelker must be used as an integral part of the operation. This trackage is essential to any maximum effort at Fort Carson. Current operating practice envisions using the "Y" for turning cars, if required, which would eliminate track 4 as an outloading site; using track 5 for incoming supplies, and using track 8 for loaded storage of the 44 nonroadable boxcars. The timber ramps at tracks 7 and 8 are unusable for end-loading vehicles and, therefore, are unavailable for current use unless new ramps are constructed or portable ramps are obtained. Portable ramps are available from the ATSF Railroad. Track 9 does not have an end ramp but, as just noted, a portable ramp could be obtained rapidly.

Outloading capability is limited more by current practices than by the physical attributes of the system. However, by using the Kelker interchange trackage and required locomotive power, a current outloading capability of 105 railcars per 24-hour day is possible.

2. Rail Outloading Analysis

A complex system structure can be viewed as a series of interconnected subsystems. The limiting subsystem within the system

establishes the maximum outloading capability. Therefore, in ascertaining the maximum rail outloading capability at Fort Carson, the following subsystem separation was used:

a. Commercial Service Capabilities

Commercial service capabilities present no problem to Fort Carson. The common carriers serving the post are the ATSF and DRGW, and their operations in the vicinity of Fort Carson are well organized. The local railroad agents in the Fort Carson district are confident that they can fulfill any task required of them, and a survey of the facilities and equipment confirmed their optimism. The Kelker yards have eight tracks and a siding that can be used to classify and store railcars. Additional railcar storage exists at Colorado Springs and at other sites very close to Fort Carson.

b. Moving to and Loading on Railcars at a Particular Site

The movement of cargo to loading sites is relatively quick and efficient since most of the equipment is self-propelled and access is along good paved roads. Traffic patterns and traffic control would have to be set up, but such measures should be standard for full-scale outloading operations. Staging areas near the outloading sites are limited, and queuing will block some streets. Recent field tests, during loading operations, revealed that vehicles move along the flatcars at an average speed of 1 mile per hour, with only one vehicle moving on a railcar at any one time. The longest string of empty flatcars used by the recommended outloading plan, assuming 60-foot car lengths (coupler to coupler) was 40 cars, the length of track 7. Using that figure, the first vehicle would reach the end of the last car 27 minutes after driving up the ramp; then blocking and bracing can be started. Loading time is insignificant in comparison with blocking and bracing time. Therefore, moving to and loading on the railcars is not the limiting subsystem. However, driving vehicles on flatcars "circus style" is dependent upon the use of bridge plates spanning the gap between the cars. According to the plan employed in our analysis, no fewer than 249 sets of bridge plates are required for simultaneous loading of 260 60-foot equivalent railcars at 11 sites.

c. Blocking, Bracing, and Safety Inspections

Blocking, bracing, and safety inspection times are difficult to project. They depend on a number of variables such as:

- (1) Crew size and experience.
- (2) Extent of the safety inspection.
- (3) Documentation.
- (4) Availability of blocking and bracing material and materials-handling equipment (MHE).

During REFORGER 76, the establishment of a 5- to 7-hour time limit for loading, blocking, and bracing at a loading site, as a reasonable goal for crews, was based upon experience and actual field tests of circus style loadings. In addition, discussions with the blocking and bracing instructors at Fort Eustis, Virginia, indicate that, to avoid wasted man-hours, there should be no more than eight men per crew, regardless of experience.

At Fort Carson, blocking and bracing material is stockpiled for two brigades, and training of blocking and bracing crews is done periodically. Therefore, blocking and bracing is not considered an immediate constraint to the rail outloading system.

d. Interchange of Empty and Loaded Railcars

An efficient interchange of empty and loaded railcars, which requires careful planning and good coordination with the common carrier, can be established at Fort Carson since the ATSF main line passes within about 3 miles of the post. The Kelker interchange yards can be used to classify incoming empty railcars, and since Colorado Springs is only a few miles away, availability of locomotive power and crews should present no problem. Also, the existence of several commercial railyards in the area makes it possible to accumulate the number of empty cars required to maintain the operation. The various plans for spotting railcars depend on the type of operation. A place or location must be provided for railcars (1) in empty storage, (2) in loaded storage, and (3) at the loading sites. In general, three balanced or equally divided areas must exist somewhere in the vicinity. If the loading sites double for the loaded storage area the rail system can be considered to have two balanced areas. An equal number of spaces should be in the empty storage and in the loading sites. This would be the case also if the loaded cars, after

being loaded, were stored on the main line track that provides service to the installation. If the empty railcars can be stored at a nearby yard owned by the common carrier and can be delivered to the post each day as needed, then only one on-post area is needed -- the loading sites. All locations on the post can be used for loading sites. The advantage of a scheme with only one area on post is obvious; the outloading rate is much greater because all available on-post spaces are used for loading. However, the disadvantage of locating the empty storage or possibly the loaded storage off post is that extra care must be given to the planning to insure that the empty cars arrive at the loading sites on schedule. Thus, if the interchange of railcars follows some semblance of the organization presented in the simulation (Appendix B), the subsystem will not limit the capabilities of rail outloading operations at Fort Carson.

e. Summary

Considering all the subsystems together, current operating procedures, bridge plate supply, and small hand tools emerge as the primary factors restraining any large rail outloading operation at Fort Carson. Therefore, elimination of the deficiencies in these areas is the major prerequisite for a successful operation. When they have been eliminated, the resultant capability should be compared with movement contingency plans. The level of operation for outloading the division in a 7-day period is approximately 260 railcars per day.

Another aspect affecting station outloading at Fort Carson is the destination of the unit material after it leaves the installation. Since Fort Carson is located more than 600 miles from any POE, all of the 4th Division's equipment must be shipped by rail. This means that, for any major operation, a maximum effort will be required with consequent high outloading rates.

Although Fort Carson's rail system and the common carriers servicing it have the potential for supporting the deployment of the 4th Division in a timely manner, the existence of capability at any one time will depend on how many of the supporting system deficiencies have been eliminated.

3. Rail System Outloading Options

The various options for outloading plans are shown in Figure 25. The configuration of the rail system places severe limitations on train movements. Specifically, the fact that all major tracks splay out from the single main line access very close to each other means that only one long string of railcars can be moved at once. Because of this and the relatively small amount of trackage at Fort Carson, use of the Kelker yards is necessary for any major outloading operation.

Track Section ^{a/} and Facilities	Railcar Capacity 60' LGS Coupler to Coupler	Item Repair Costs	Day Loading Only				
			Plan 1 ^{b/} Present Capability 101 RCPD	Plan 2 ^{b/} 154 RCPD	Plan 3 185 RCPD	Plan 4 207 RCPD	Plan 5 260 RCPD
Post Main Line		102,322			X	X	X
Track 1	20		X	X	X	X	X
Track 2	16		X	X	X	X	X
Track 3	20						X
Track 4	31				X	X	X
Track 5	22					X	X
Track 6	40	34,364 ^{c/}	X	X	X	X	X
Track 7	40	4,276 ^{d/}		X	X	X	X
Track 8	33	3,207 ^{e/}					X
Track 9	9	333 ^{f/}		X	X	X	X
Track 10	14	8,109 ^{f/}	X	X	X	X	X
Track 11	15	333 ^{e/}	X	X	X	X	X
End Ramp		8,600 ^{g/}		7,9 ^{h/}	7,9 ^{i/}	7,9 ^{i/}	3,7,9 ^{i/}
Track 5 Platform/ Ramp		10,500 ^{k/}			k/	k/	k/
Total Cost					177,437	177,437	189,244
<u>Legend</u> X - Track is upgraded and used for that option. RCPD - Railcars per 24-hour day. ^{a/} Cost estimates provided by Fort Carson Facilities Engineering Personnel. ^{b/} No costs were shown for Plans 1 and 2 since all track is currently usable; however, maintenance is required to insure continued effectiveness and to improve reliability. ^{c/} Perforated culvert west side of track, grading ditch, replace ties and plates. ^{d/} Realign and surface track. ^{e/} Correct drainage. ^{f/} Tie replacement. ^{g/} Cost to construct end ramp. ^{h/} Portable end ramps are used. ^{i/} Construct end ramps for these tracks. ^{j/} Remove timber end ramp and surface approach to end of track for portable bilevel ramp (available from ATSF). If bilevel railcars are unavailable, portable ramp can still be used for end-loading vehicles. ^{k/} Pave platform leading from existing ramp to bulkhead; widen near center and provide with ramp for forklift access.							

Figure 25. Fort Carson Rail System Outloading Options.

Five plans for daylight-only loading were developed for only two balanced areas: loading sites and empty storage. Of course, the loaded storage must be somewhere, and in this case, the loading sites have a dual function by providing the loaded storage also. The two balanced areas approach is possible because of the short distance to Kelker, where empty railcars can be accumulated for the next day, and because the main line locomotives can go onto the post and perform switching operations for train make up. Therefore, through proper planning, main line locomotives can be on post and waiting to begin coupling loaded cars as soon as the blocking and bracing inspection is finished. When this procedure is used, the storage area for loaded cars is not necessary; therefore, more loading sites are available and, thus, the daily output of railcars is increased.

The procedure for use of only two balanced areas works according to the following sequence for Plan 5, the recommended plan: loading, blocking, and bracing begin at 0700 hours at all loading sites; these operations, as well as inspection of loaded cars, are completed at 1400 hours. Main line locomotives begin picking up the loaded cars on post. Three trains, 87 cars each, must be picked up; the last train leaves post at 1840 hours. Meanwhile, locomotives at Kelker are picking up empties that have been classified by type for specific loading tracks on post. The first train of empties arrives at 2000 hours and switching engines begin positioning the cars. All empties are in position at 0335 hours the next day; the cycle requires 20 hours 45 minutes. This allows 3 hours 15 minutes for contingencies, such as placing cars on the wrong track, equipment breakdown, and scheduling problems, which are bound to occur in such a large operation. The switching sequence plan is shown in Appendix B.

Plan 1 was developed using only track that is currently available and does not use any track that is being held open for other purposes. Present procedures hold tracks 3 and 4 open to turn cars if necessary; track 5 is left open for incoming supplies, if required, and track 8 is tied up to store the 44 USAX boxcars.

Plan 2 omits tracks 3 and 4 to leave the "Y" open for turning cars; this is not necessary as all cars will be classified at Kelker and checked for proper consist before being delivered to post. Omitting these tracks eliminates two good loading sites capable of handling 51 cars per day, and is not recommended; also, part of the 44 USAX nonroadable boxcars can be positioned on track 12, which is a step toward freeing track 8 for use as an outloading site. Plan 2 also omits use of track 5, which is being held open

for incoming supplies. Arrangements should be made to have incoming supplies that are to be shipped by rail during the outloading operation delayed if possible or shipped by truck. If this is not possible, the railcars should be unloaded onto trucks at a siding in Colorado Springs and the supplies delivered to the post; or, if the items are not needed, the railcars held until the operation is over. Eliminating the use of this track deprives the operation of 22 cars per day and is not recommended. Finally, Plan 2 omits the use of track 8, which is to be used for the 44 USAX boxcars. Other arrangements should be made so that the cars can be designated as surplus; if not, part of them can be stored on track 12 and the remainder on the siding at Kelker.

Plan 3 adds track 4 to achieve the added capability and Plan 4 adds track 5.

Plan 5, the recommended plan, is shown in detail in Appendix B. It is recommended because it:

- a. Fulfills the requirement to outload the division in 7 days, and is the maximum outloading rate for the existing rail system.
- b. Minimizes conflicts between vehicle convoys en route to outloading sites and rail switching operations. Loading, blocking, and bracing are accomplished during daylight hours, and train operations are carried out in late afternoon and at nighttime.
- c. Schedules tedious work, such as nailing, cable cutting, and so forth, to be done during the daylight hours, which is more efficient and safer.
- d. Provides 3 hours 15 minutes per day for contingencies.
- e. Saves energy because less area lighting will be required.

If incoming supplies shipped by rail cannot be handled by any of the means indicated above, they could be handled during the night while empties are being brought in for the next day's loading; track 5 could be left open, and the incoming supplies could be delivered on track 5 at about 0345, the end of the cycle. By taking the contingency time (3 hours 15 minutes) from this day and delaying the start of the next cycle (3 hours 15 minutes), 6-1/2 hours are available to bring in the supplies, unload them, remove the cars, and bring in empties for track 5. This would affect loading at track 5 only; other loading sites could start work at 0700 as usual.

4. Physical Improvements and Additions

Items listed below are all minimum requirements to provide the recommended outloading rate of 260 railcars per day, using existing trackage.

- a. Acquire a minimum stock of blocking and bracing material needed to supplement the post organic supply for handling all equipment when a rapid deployment of post units is required.
- b. Acquire bridge plates for volume outloading of vehicles at Fort Carson.
- c. Acquire sufficient small tools, including power saws, cable cutters, wrecking bars, cable tensioning devices, hammers, and so forth, to permit operation of blocking and bracing crews at all outloading sites.
- d. Upgrade all track, indicated by Plan 5 in Figure 25, to federal track safety standard, class 2 for main line and class 1 for all other track as a minimum, with a goal of improving all tracks to class 2 (Appendix A).
- e. Check all switch points and frogs, and install switch standards with lights.
- f. Construct three heavy timber portable or permanent end-loading ramps for loading vehicles at tracks 3, 7, and 9, and upgrade ramp platform at track 5.
- g. Improve drainage and weed control.

5. Discussion of Time and Costs

a. Physical Improvements

The cost estimates used in this section were supplied by Fort Carson facilities engineering personnel. No times were given for projected completion dates on any improvements, but it should be noted that a full division could be in a poor contingency situation at Fort Carson for some time without the capability to move in an acceptable time frame. The ramps should be constructed for use in the planned REFORGER operation and as much track upgraded as time permits, with a 1-year target recommended for completion of all work.

Figure 25 contains detailed cost figures. Plans 1 and 2 indicate only use of trackage that is currently available and in operating condition, and omit tracks that would not be used due to current practices. Therefore, no costs are enumerated for them. Whereas, the plans in the other columns use trackage that will require maintenance and/or repair either immediately or in the near future, and show specific costs for each plan.

b. Load Time Versus Equipment Type

Two basic types of outloading operations are mobilization and administrative. Mobilization moves are not artificial: there is genuine urgency since these only occur in times of national emergency. The most rapid method of loading and securing mobile equipment on railcars is circus style. For example, if unit integrity is to be maintained, 2-1/2-ton trucks that are to pull trailers drive onto the string of railcars towing their trailers, and the equipment is secured in this configuration. This procedure is fast but railcar space is wasted. During actual field tests on standard-type railcars, the loading, securing, and inspection of 2-1/2-ton trucks, two per railcar, site times varied from 5 hours for flatcars with chain tiedowns to 6-1/2 hours for flatcars without chain tiedowns, Figure 26. This was a fast,

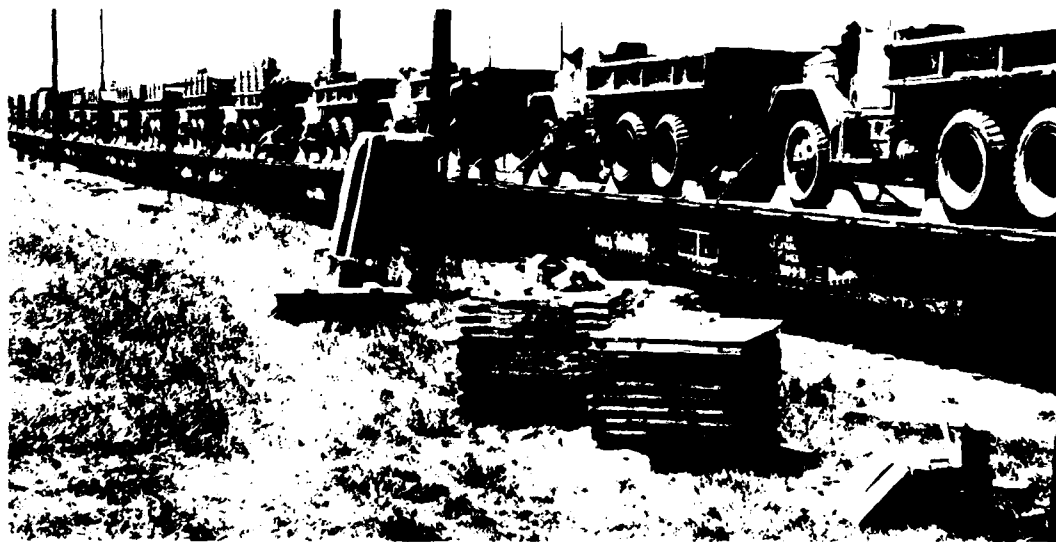


Figure 26. Circus-Style Loading of 2-1/2-Ton Trucks, Total Loading, Blocking and Bracing, and Inspection Time, 5 Hours.

efficient operation. Other similar operations that could occur in a mobilization-type move, for most Army units, include loading various sizes of containers on standard-type flatcars by using forklifts. This operation, including loading and securing, and so forth, was accomplished in 5-1/2 hours. Site loading and securing times for semitrailers and vans on TOFC cars averaged 4 hours. All things considered, the circus-style loading operations indicate that, for mobilization moves, the loading, blocking and bracing, and inspections can be accomplished within 5 to 7 hours for most types of equipment.

However, if a unit has a significant number of small items, such as "mules," they are likely to require 10 hours site time; this should be considered, rather than to assume that the work could be accomplished within 7 hours.

For an administrative-type move, there is plenty of time for planning; night operations are not necessary except to finish work that is not completed during daylight hours and to switch railcars. This added flexibility helps to solve unforeseeable problems. The administrative-type move allows time for accumulating special-type railcars, such as bilevel autoracks and TOFC and COFC cars, which significantly reduce both labor and costs. For instance, small vehicles, jeeps, 3/4-ton trucks, 1-1/4-ton trucks, and gamma goats can be loaded on bilevel cars (Figure 27); semitrailers and vans can be



Figure 27. Lower Level of Bilevel Cars Loaded With Jeeps, Gamma Goats, 3/4-Ton Trucks, and 1-1/4-Ton Trucks.

loaded on TOFC cars; and MILVANS, for which there are no chassis, can be loaded on COFC cars. Mobile equipment, some 2-1/2-ton trucks, and all smaller vehicles can be loaded on bilevel railcars. These three types of specific railcars require no blocking and bracing except that integral to the car.

Loading and securing times for bilevels varied from an average of 7-1/2 hours for a string of cars that were fully equipped with chain tiedowns, to 10-3/4 hours for those where cable tiedowns had to be fabricated to replace missing chain tiedowns. The average total time for TOFC cars was 4 hours. The administrative-type loads that require relatively longer times and effort are illustrated in Figures 28 and 29. This type of load required a total site time of 10 to 11 hours. In general, administrative-type operations should be planned for daylight hours, leaving night hours available for finishing up sites that started late or were slowed by problems and railcar switching. This type of planning allows enough flexibility to resolve problems and complete the operation on schedule.



Figure 28. Administrative Load, Mules.



Figure 29. Administrative Load, Forklift, Wrecker, 1/4-Ton Trailers.

For mobilization-type moves, site time to load and secure equipment on a string of railcars should be accomplished in 5 to 7 hours; administrative-type moves, 4 to 11 hours. The time/motion studies conducted during the exercise resulted in the accumulation of valuable information for planning future station outloading operations and is available at MTMCTEA. It should be noted that loading times are relatively minor as compared with times required to secure the equipment. As an example, a jeep can drive across an 89-foot-long bilevel car in 1 minute, and a forklift truck can load a container in 2 minutes 12 seconds. So, loading times are not the problem, and as soon as the first vehicle is in position, several simultaneous operations are in effect -- loading, blocking, and tying down. Thus for future planning, site times should be used. As a general rule: 5 to 7 hours for a mobilization move, and 4 to 11 hours for an administrative move. The minimum of 5 hours is used in the mobilization move since the assumption should be made that only standard-type railcars are available. The minimum of 4 hours is used in the administrative move since there is time to plan and assemble the type of railcars that are most appropriate for the equipment to be moved. The 4 hours in this instance was the average time required to load and secure semitrailers and vans on a string of twelve 89-foot-long TOFC cars.

To minimize the number of faulty or unacceptable loads that have to be done over, inspection of the loaded cars by the railroad should proceed simultaneously with the work.

c. Transportation Equipment Costs - Bilevel Railcars Versus
54-Foot Standard Flatcars

A cost comparison using nine different types of equipment scheduled to be outloaded in the REFORGER 77 exercise reveals that \$129,431 in transportation and materials (timber, cable, and so forth) can be saved by shipping this equipment by bilevel railcars rather than by standard-type 54-foot flatcars. The equipment items vary from 1/4-ton trailers to 2-1/2-ton trucks and total 623 vehicles, which could be transported on 55 bilevel railcars, see Table II for details and Appendix C for more information on special-purpose railcars.

TABLE II
COST COMPARISON BILEVELS VERSUS 54-FOOT FLATCARS

Column Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Item No.	Vehicle Type	Model Number	Weight Lbs	Height Inches	Length Inches	Quantity Shipped	Quantity on 50-Ft Railcar	Dollars	No. of 54 Ft-Cars Required	(6 x 9) Cost for Trans Item	Quantity on 89-Ft Bilevel	Dollars	No. of Bilevels Required	(12 x 13) Cost for Trans Item
1	2-1/2-Ton Truck	M35A2	13,360	80.8	264.8	110	2	2,413	55	132,715	6	7,238	18	130,284
2	Gamma Cost, 1-1/4-Ton	M561	7,480	71.9	231.1	27	2	2,167	13	28,171	8	5,402	4	21,608
3	M105A2 1-1/2-Ton Trailer	M105A2	2,670	82.0	166.0	113	3	2,167	37	80,179	12	3,612	9	32,508
4	1/4-Ton Trailer	M416	580	44.0	108.5	136	10	2,167	14	30,338	36	3,612	4	25,284
5	400 Gal Water Trailer	M49A1	2,530	80.5	161.4	20	4	2,167	5	10,835	12	3,612	2	7,224
6	1-1/4-Ton Truck	M860	4,635	73.5	218.5	11	2	2,167	5	10,835	6	3,612	2	7,224
7	3/4-Ton Trailer	M101	1,350	50.0	147.0	8	4	2,167	2	4,334	12	3,612	1	3,612
8	1/4-Ton Truck	M151	2,350	52.5	131.5	180	7	2,167	25	54,175	14	3,612	13	46,956
9	1-1/4-Ton Comb Truck	M884	4,648	67.5	218.5	18	2	2,167	9	19,503	8	3,612	2	4,334
Total						623	2			371,085			55	279,034
SUMMARY														
Total cost to ship the 9 different items (623 vehicles) by 54-foot-long standard flatcars, Column 10														
Total cost to ship the 9 different items (623 vehicles) by 89-foot-long bilevel flatcars, Column 14														
Savings in transportation costs if shipped by bilevel flatcars, (Column 10 - Column 14)														
Additional costs of blocking and bracing materials if shipped by 54-foot standard flatcars														
Total savings if these 9 items shipped by bilevel versus 54-foot flatcar														
									\$371,085					
									\$279,034					
									\$92,051					
									37,380					
									(\$60 x 623)					
									\$175,431					

III. ANALYSIS OF COMMERCIAL RAIL FACILITIES WITHIN 25 MILES OF FORT CARSON

All rail facilities within 25 miles of Fort Carson were analyzed to determine the feasibility of using them during full-scale rail outloading operations at the installation. Many factors were considered in making the determinations, including:

- a. Road access to the facility
- b. Type of facility available--ramps, lighting
- c. Equipment staging and queuing areas
- d. Railcar storage and loading capacities
- e. Track and facility maintenance conditions
- f. Main line activity levels
- g. Added expense of using commercial facilities
- h. Security problems
- i. Complication of splitting or relocating operations

Several considerations narrowed the field of potentially acceptable facilities. Facilities belonging to the main line railroad are usually the best alternatives, because rail facilities belonging to private concerns are generally unavailable and unsuited for military rail outloading operations. Also, those facilities located more than a few miles from the post need to have significant potential to make their use feasible. The representatives of the ATSF and DRGW railroads assisted in the determination of off-post rail capabilities, which are summarized in Table III.

Specific conditions and/or deficiencies at the sites are: the trackage and the siding at Kelker are essential to any major outloading operation at Fort Carson. They should be used for classifying incoming empty railcars to be used in the operation. Periodic inspections should be made to insure that all trackage is maintained in usable condition. Both the ATSF and DRGW have one piggyback ramp each in Colorado Springs; two other sites that are relatively close, Hanover and Fountain, could be used as outloading sites with portable ramps. None of the sites have lighting, and only small staging areas are available at the four sites mentioned above.

TABLE III
RAILROAD FACILITIES WITHIN 25 MILES OF FORT CARSON

Location Railroad Figures	Road Distance From Ft Carson (Miles)	Type of Trackage Available	Type of Ramps	Lighting	Surface Conditions	Staging Area	Storage Capacity Railcars 60-Ft LG's	Road Access to Site	Remarks
Kelker ATSF DRGW Fig 30 Through 33	2	Interchange Yards, Siding	None	None	Poor Natural Ground	Open Fields	326	By 2-Lane Paved Road	This trackage is critical to any major outloading operation at Fort Carson. It should be used for classifying incoming empty cars to be used in the operation. Trackage should be checked periodically to insure tha' it is maintained in usable condition.
Colorado Springs ATSF Fig 34 and 35 DRGW Fig 36 and 37	5	Classification Sidings Spurs	Two Piggy- back Ramps One each Railroad	None	Good Gravel Natural Soil	Some Along Side Tracks	255	By City Streets	The piggyback ramps could be used if necessary but both will only hold a few cars unless going through the switch onto an adjacent track is acceptable.
Fountain ATSF	10	2 Sidings	None	None	Good Cinders	Good Alongside ATSF Track East Side of Main Line	75	Good By City Street	Siding on east side of main line could be used as out- loading site if portable ramp is used.
Fountain DRGW	10	Siding	None	None	Embankment	None	65	None	Good for storage only.
S Buttes, N Buttes, Henkel	25	Sidings	N/A	N/A	N/A	N/A	195	N/A	These sidings are all south of Fort Carson. One siding at S Buttes would be suit- able as an outloading site. Did not inspect Henkel.
Academy Monument	25	Sidings	N/A	N/A	N/A	N/A	241	N/A	These sidings are north of Fort Carson. Did not in- spect.

Portable ramps could possibly be used at some of the other sites for day-time operations, but this is not recommended for any of the sites because most of the trackage will be needed for storage to support local service and full-scale activity at Fort Carson. Possible complications involving security and splitting of operations are two important reasons to restrict use of off-post facilities for storage of empty cars. The major sites are illustrated in Figures 30 through 37.



Figure 30. Kelker Interchange Yard, From Bottom of Photograph up - Main Line
of ATSF, Siding, Next Four Tracks Owned by ATSF, Tracks at Top
Owned by DRGW.



Figure 31. Kelker DRGW Yard.



Figure 32. Main Line of ATSF at Kelker, Left Track.



Figure 33. Fort Carson Main Line at Kelker.



Figure 34. ATSF Railyard, Colorado Springs.



Figure 35. ATSF Railyard, Colorado Springs (Aerial View).



Figure 36. Borew Railway, Colorado Springs (Aerial View).



Figure 37. DRGW Railyard, Colorado Springs.

IV. SPECIAL EQUIPMENT FOR EXPEDITING THE OUTLOADING OF MILVANS

A large supply of trailer-on-flatcar railcars are usually in the system and container-on-flatcar railcars may be available. These cars should be used to transport semitrailers and MILVANS. If COFC or TOFC flatcars are not available, some blocking and bracing time and expense can be saved by using bulkhead flatcars for transporting MILVANS. See Appendix C for additional information.

V. CONCLUSIONS

1. The railroad tracks at Fort Carson are in generally good condition and all are usable, although some maintenance and ramp construction is required. Current rail outloading capability is limited by lack of necessary supporting elements, such as outloading plans and small hand tools.
2. Because of Fort Carson's location, over 600 miles from all POEs, all equipment would have to be outloaded by rail. Necessary supplies should be stocked accordingly.
3. Estimated minimal cost for upgrading the rail system to improve operating efficiency, insure a continued effective system, and achieve an outloading rate of 260 railcars per 24-hour day is \$189,244. At this rate, the division equipment could be outloaded by rail in 7 days after receipt of sufficient railcars to permit full-scale operations.
4. Physical improvements to the rail system and other additions for outloading (sec II, para D4) are required.
5. The Kelker yards near Fort Carson should be used for classifying incoming empty railcars destined for Fort Carson, as to type, length, height, and position in string, before movement onto the installation.
6. Adequate railcar storage capacity is available to support a volume outloading of Fort Carson's units.
7. The trackage in the vicinity of Fort Carson is in fair to good condition.
8. The ATSF and DRGW representatives did not express any reservations regarding the outloading of Fort Carson units concurrently with other demands.
9. Fort Carson transportation personnel should coordinate planning of impending outloading operations with the ATSF and DRGW at the earliest possible date.
10. Because of the small amount of trackage, any track removed as a result of future construction should be replaced by a similar track in an appropriate area.
11. Since only one set of scales is available, equipment weighing should begin several days before outloading begins.

12. The systems analysis of the existing rail trackage at Fort Carson and Kelker indicates that one main line locomotive and two switching engines will be required, for train movements and for shifting of empty cars, to produce an output of 260 railcars per 24-hour day. These are in addition to the locomotive power required to pick up three loaded trains per day.
13. For administrative-type moves, where lead time is plentiful and costs must be considered, special-purpose railcars such as bilevel auto-racks and TOFC and COFC cars, which are more cost effective than the standard types, should be used.
14. During mobilization moves, when time is more critical than money, the use of special-purpose railcars may not be possible due to short lead time and the relatively short supply of cars versus high demand by numerous unit moves.
15. For the REFORGER move, bilevel railcars could be loaded on track 8. Since the timber end ramp is structurally unsound, it could be removed and a portable ramp could be obtained from the ATSF Railroad. This would provide for 20 bilevels per day; or, track 3 could be used for a 12-car per day capacity.
16. The 44 USAX nonroadable boxcars that are used for supply storage eliminate one outloading site; consequently, other arrangements should be made to store the supplies, and the cars should be designated as surplus.

VI. RECOMMENDATIONS

1. Undertake those items listed in section II, paragraph D4, "Physical Improvements and Additions." These improvements will provide a rail system capability of 260 railcars per day and will insure a continued effective rail system.
2. Using the simulation in Appendix B as an example, prepare a detailed unit outloading plan, specifying unit assignments at loadout sites and movement functions.
3. Coordinate rail outloading plans with the ATSF and DRGW Railroads at the earliest possible date.
4. Continue rail facility maintenance to insure an effective rail system.
5. Provide advance training for blocking and bracing crews.
6. Station a switching engine(s) at Kelker yards and use it to classify incoming empty railcars.
7. Station road guards at all railroad crossings during train movements and provide all train crewmen with walkie-talkies to insure a more safe and efficient operation.
8. Replace all track removed due to future facilities construction with a like amount in an appropriate location.
9. Keep abreast of the ATSF and DRGW Railroad plans for maintenance and/or removal of the trackage at Kelker yards, as this trackage is essential for support of major outloading operations.
10. Make arrangements with the ATSF and/or the DRGW Railroad(s) for the services of one main line locomotive and one switching engine to work with the Government locomotive, at Kelker and Fort Carson, to insure an outloading production rate of 260 railcars per day. These are in addition to the locomotive power required to pick up three loaded trains per day during the operation.
11. Several days before outloading begins, start weighing equipment that is to be outloaded.
12. Use special-purpose railcars, such as bilevel autoracks for small vehicles, TOFC cars for semitrailers and vans, and COFC cars for

MILVANS, for administrative-type moves and, as available, for mobilization moves.

13. Load bilevel railcars on track 8 (20 per day). Remove deteriorated timber end ramp and obtain a portable ramp from the ATSF Railroad for the move; or use track 3 (12 per day).
14. Provide warehousing for the supplies that are stored in the 44 USAX nonroadable boxcars, and designate the boxcars as surplus.

APPENDIX A

TRACK SAFETY STANDARDS *

PART 213—TRACK SAFETY STANDARDS

Subpart A—General

- | | |
|--------|---|
| Sec. | |
| 213.1 | Scope of part. |
| 213.3 | Application. |
| 213.5 | Responsibility of track owners. |
| 213.7 | Designation of qualified persons to supervise certain renewals and inspect track. |
| 213.9 | Classes of track: operating speed limits. |
| 213.11 | Restoration or renewal of track under traffic conditions. |
| 213.13 | Measuring track not under load. |
| 213.15 | Civil penalty. |
| 213.17 | Exemptions. |

Subpart B—Roadbed

- | | |
|--------|-------------|
| 213.31 | Scope. |
| 213.33 | Drainage. |
| 213.37 | Vegetation. |

Subpart C—Track Geometry

- | | |
|--------|--------|
| 213.51 | Scope. |
| 213.53 | Gage. |

- | | |
|--------|---|
| Sec. | |
| 213.55 | Alignment. |
| 213.57 | Curves; elevation and speed limitations. |
| 213.59 | Elevation of curved track; runoff. |
| 213.61 | Curve data for Classes 4 through 6 track. |
| 213.63 | Track surface. |

Subpart D—Track Structure

- | | |
|---------|---------------------------|
| 213.101 | Scope. |
| 213.103 | Ballast; general. |
| 213.105 | Ballast; disturbed track. |
| 213.109 | Crossties. |
| 213.113 | Defective rails. |
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| 213.117 | Rail end batter. |
| 213.119 | Continuous welded rail. |

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Subpart E—Track Appliances and Track-Related Devices

- | | |
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Subpart F—Inspection

- | | |
|---------|---|
| 213.231 | Scope. |
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APPENDIX A—MAXIMUM ALLOWABLE OPERATING SPEEDS FOR CURVED TRACK

AUTHORITY: The provisions of this Part 213 issued under sections 202 and 209, 84 Stat. 971, 975; 45 U.S.C. 431 and 438 and § 1.49(n) of the Regulations of the Office of the Secretary of Transportation; 49 CFR 1.49(n).

SOURCE: The provisions of this Part 213 appear at 36 F.R. 20336, Oct. 20, 1971, unless otherwise noted.

Subpart A—General

§ 213.1 Scope of part.

This part prescribes initial minimum safety requirements for railroad track

*Extracted from Title 49, Transportation, Parts 200 to 999, pp 8-19, Code of Federal Regulations, 1973.

that is part of the general railroad system of transportation. The requirements prescribed in this part apply to specific track conditions existing in isolation. Therefore, a combination of track conditions, none of which individually amounts to a deviation from the requirements in this part, may require remedial action to provide for safe operations over that track.

§ 213.3 Application.

(a) Except as provided in paragraphs (b) and (c) of this section, this part applies to all standard gage track in the general railroad system of transportation.

(b) This part does not apply to track—

(1) Located inside an installation which is not part of the general railroad system of transportation; or

(2) Used exclusively for rapid transit, commuter, or other short-haul passenger service in a metropolitan or suburban area.

(c) Until October 16, 1972, Subparts A, B, D (except § 213.109), E, and F of this part do not apply to track constructed or under construction before October 15, 1971. Until October 16, 1973, Subpart C and § 213.109 of Subpart D do not apply to track constructed or under construction before October 15, 1971.

§ 213.5 Responsibility of track owners.

(a) Any owner of track to which this part applies who knows or has notice that the track does not comply with the requirements of this part, shall—

(1) Bring the track into compliance; or

(2) Halt operations over that track.

(b) If an owner of track to which this part applies assigns responsibility for the track to another person (by lease or otherwise), any party to that assignment may petition the Federal Railroad Administrator to recognize the person to whom that responsibility is assigned for purposes of compliance with this part. Each petition must be in writing and include the following—

(1) The name and address of the track owner;

(2) The name and address of the person to whom responsibility is assigned (assignee);

(3) A statement of the exact relationship between the track owner and the assignee;

(4) A precise identification of the track;

(5) A statement as to the competence and ability of the assignee to carry out the duties of the track owner under this part; and

(6) A statement signed by the assignee acknowledging the assignment to him of responsibility for purposes of compliance with this part.

(c) If the Administrator is satisfied that the assignee is competent and able to carry out the duties and responsibilities of the track owner under this part, he may grant the petition subject to any conditions he deems necessary. If the Administrator grants a petition under this section, he shall so notify the owner and the assignee. After the Administrator grants a petition, he may hold the track owner or the assignee or both responsible for compliance with this part and subject to penalties under § 213.15.

§ 213.7 Designation of qualified persons to supervise certain renewals and inspect track.

(a) Each track owner to which this part applies shall designate qualified persons to supervise restorations and renewals of track under traffic conditions. Each person designated must have—

(1) At least—

(i) One year of supervisory experience in railroad track maintenance; or

(ii) A combination of supervisory experience in track maintenance and training from a course in track maintenance or from a college level educational program related to track maintenance;

(2) Demonstrated to the owner that he—

(i) Knows and understands the requirements of this part;

(ii) Can detect deviations from those requirements; and

(iii) Can prescribe appropriate remedial action to correct or safely compensate for those deviations; and

(3) Written authorization from the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements in this part.

(b) Each track owner to which this part applies shall designate qualified persons to inspect track for defects. Each person designated must have—

(1) At least—

(i) One year of experience in railroad track inspection; or

(ii) A combination of experience in track inspection and training from a course in track inspection or from a college level educational program related to track inspection;

(2) Demonstrated to the owner that he—

(i) Knows and understands the requirements of this part;

(ii) Can detect deviations from those requirements; and

(iii) Can prescribe appropriate remedial action to correct or safely compensate for those deviations; and

(3) Written authorization from the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements of this part, pending review by a qualified person designated under paragraph (a) of this section.

(c) With respect to designations under paragraphs (a) and (b) of this section, each track owner must maintain written records of—

(1) Each designation in effect;

(2) The basis for each designation, and

(3) Track inspections made by each designated qualified person as required by § 213.241.

These records must be kept available for inspection or copying by the Federal Railroad Administrator during regular business hours.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 875, Jan. 5, 1973]

§ 213.9 Classes of track: operating speed limits.

(a) Except as provided in paragraphs (b) and (c) of this section and §§ 213.57 (b), 213.59(a), 213.105, 213.113 (a) and (b), and 213.137 (b) and (c), the following maximum allowable operating speeds apply:

[In miles per hour]

Over track that meets all of the requirements prescribed in this part for—	The maximum allowable operating speed for freight trains is—	The maximum allowable operating speed for passenger trains is—
Class 1 track	10	15
Class 2 track	25	30
Class 3 track	40	60
Class 4 track	60	80
Class 5 track	80	90
Class 6 track	110	110

(b) If a segment of track does not meet all of the requirements for its intended class, it is reclassified to the next lowest class of track for which it does meet all of the requirements of this part. However, if it does not at least meet the requirements for class 1 track, no operations may be conducted over that segment except as provided in § 213.11.

(c) Maximum operating speed may not exceed 110 m.p.h. without prior approval of the Federal Railroad Administrator. Petitions for approval must be filed in the manner and contain the information required by § 211.11 of this chapter. Each petition must provide sufficient information concerning the performance characteristics of the track, signaling, grade crossing protection, trespasser control where appropriate, and equipment involved and also concerning maintenance and inspection practices and procedures to be followed, to establish that the proposed speed can be sustained in safety.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 875, Jan. 5, 1973; 38 FR 23405, Aug. 30, 1973]

§ 213.11 Restoration or renewal of track under traffic conditions.

If, during a period of restoration or renewal, track is under traffic conditions and does not meet all of the requirements prescribed in this part, the work and operations on the track must be under the continuous supervision of a person designated under § 213.7(a).

§ 213.13 Measuring track not under load.

When unloaded track is measured to determine compliance with requirements of this part, the amount of rail movement, if any, that occurs while the track is loaded must be added to the measurement of the unloaded track.

[38 FR 875, Jan. 5, 1973]

§ 213.15 Civil penalty.

(a) Any owner of track to which this part applies, or any person held by the Federal Railroad Administrator to be responsible under § 213.5(c), who violates any requirement prescribed in this part is subject to a civil penalty of at least \$250 but not more than \$2,500.

(b) For the purpose of this section, each day a violation persists shall be treated as a separate offense.

Exemptions.

(a) Any owner of track to which this part applies may petition the Federal Railroad Administrator for exemption from any or all requirements prescribed in this part.

(b) Each petition for exemption under this section must be filed in the manner and contain the information required by § 211.11 of this chapter.

(c) If the Administrator finds that an exemption is in the public interest and is consistent with railroad safety, he may grant the exemption subject to any conditions he deems necessary. Notice of each exemption granted is published in the FEDERAL REGISTER together with a statement of the reasons therefor.

Subpart B—Roadbed

§ 213.31 Scope.

This subpart prescribes minimum requirements for roadbed and areas immediately adjacent to roadbed.

§ 213.33 Drainage.

Each drainage or other water carrying facility under or immediately adjacent to the roadbed must be maintained and kept free of obstruction, to accommodate expected water flow for the area concerned.

§ 213.37 Vegetation.

Vegetation on railroad property which is on or immediately adjacent to roadbed must be controlled so that it does not—

- (a) Become a fire hazard to track-carrying structures;
- (b) Obstruct visibility of railroad signs and signals;
- (c) Interfere with railroad employees performing normal trackside duties;
- (d) Prevent proper functioning of signal and communication lines; or
- (e) Prevent railroad employees from visually inspecting moving equipment from their normal duty stations.

Subpart C—Track Geometry

§ 213.51 Scope.

This subpart prescribes requirements for the gage, alignment, and surface of track, and the elevation of outer rails and speed limitations for curved track.

§ 213.53 Gage.

(a) Gage is measured between the heads of the rails at right angles to the

rails in a plane five-eighths of an inch below the top of the rail head.

(b) Gage must be within the limits prescribed in the following table:

Class of track	The gage of tangent track must be—		The gage of curved track must be—	
	At least—	But not more than—	At least—	But not more than—
1.....	4' 8"	4' 9 ³ / ₄ "	4' 8"	4' 9 ³ / ₄ "
2 and 3.....	4' 8"	4' 9 ¹ / ₂ "	4' 8"	4' 9 ¹ / ₂ "
4.....	4' 8"	4' 9 ¹ / ₄ "	4' 8"	4' 9 ¹ / ₄ "
5.....	4' 8"	4' 9"	4' 8"	4' 9 ¹ / ₂ "
6.....	4' 8"	4' 8 ³ / ₄ "	4' 8"	4' 9"

§ 213.55 Alinement.

Alinement may not deviate from uniformity more than the amount prescribed in the following table:

Class of track	Tangent track	Curved track
	The deviation of the mid-offset from 62-foot line ¹ may not be more than—	The deviation of the mid-ordinate from 62-foot chord ² may not be more than—
1.....	5"	5"
2.....	3"	3"
3.....	1 ³ / ₄ "	1 ³ / ₄ "
4.....	1 ¹ / ₂ "	1 ¹ / ₂ "
5.....	3/4"	3/4"
6.....	1/2"	3/8"

¹ The ends of the line must be at points on the gage side of the line rail, five-eighths of an inch below the top of the railhead. Either rail may be used as the line rail, however, the same rail must be used for the full length of that tangential segment of track.

² The ends of the chord must be at points on the gage side of the outer rail, five-eighths of an inch below the top of the railhead.

§ 213.57 Curves; elevation and speed limitations.

(a) Except as provided in § 213.63, the outside rail of a curve may not be lower than the inside rail or have more than 6 inches of elevation.

(b) The maximum allowable operating speed for each curve is determined by the following formula:

$$V_{max} = \sqrt{\frac{E_s + 3}{0.0007d}}$$

where

V_{max} = Maximum allowable operating speed (miles per hour).

E_s = Actual elevation of the outside rail (inches).

d = Degree of curvature (degrees).

Appendix A is a table of maximum allowable operating speed computed in accordance with this formula for various elevations and degrees of curvature.

§ 213.59 Elevation of curved track; runoff.

(a) If a curve is elevated, the full elevation must be provided throughout the curve, unless physical conditions do not permit. If elevation runoff occurs in a curve, the actual minimum elevation must be used in computing the maximum allowable operating speed for that curve under § 213.57(b).

(b) Elevation runoff must be at a uniform rate, within the limits of track surface deviation prescribed in § 213.63, and it must extend at least the full length of the spirals. If physical conditions do not permit a spiral long enough to accommodate the minimum length of

runoff, part of the runoff may be on tangent track.

§ 213.61 Curve data for Classes 4 through 6 track.

(a) Each owner of track to which this part applies shall maintain a record of each curve in its Classes 4 through 6 track. The record must contain the following information:

- (1) Location;
- (2) Degree of curvature;
- (3) Designated elevation;
- (4) Designated length of elevation runoff; and
- (5) Maximum allowable operating speed.

[38 FR 875, Jan. 5, 1973]

§ 213.63 Track surface.

Each owner of the track to which this part applies shall maintain the surface of its track within the limits prescribed in the following table:

Track surface	Class of track					
	1	2	3	4	5	6
The runoff in any 31 feet of rail at the end of a raise may not be more than	3½"	3"	2"	1½"	1"	½"
The deviation from uniform profile on either rail at the midordinate of a 62-foot chord may not be more than	3"	2¾"	2¼"	2"	1¾"	½"
Deviation from designated elevation on spirals may not be more than	1¾"	1½"	1¼"	1"	¾"	½"
variation in cross level on spirals in any 31 feet may not be more than	2"	1¾"	1½"	1"	¾"	½"
Deviation from zero cross level at any point on tangent or from designated elevation on curves between spirals may not be more than	3"	2"	1¾"	1¼"	1"	½"
The difference in cross level between any two points less than 62 feet apart on tangents and curves between spirals may not be more than	3"	2"	1¾"	1¼"	1"	½"

Subpart D—Track Structure

§ 213.101 Scope.

This subpart prescribes minimum requirements for ballast, crossties, track assembly fittings, and the physical condition of rails.

§ 213.103 Ballast; general.

Unless it is otherwise structurally supported, all track must be supported by material which will—

(a) Transmit and distribute the load of the track and railroad rolling equipment to the subgrade;

(b) Restrain the track laterally, longitudinally, and vertically under dynamic loads imposed by railroad rolling

equipment and thermal stress exerted by the rails;

(c) Provide adequate drainage for the track; and

(d) Maintain proper track cross-level, surface, and alignment.

§ 213.105 Ballast; disturbed track.

If track is disturbed, a person designated under § 213.7 shall examine the track to determine whether or not the ballast is sufficiently compacted to perform the functions described in § 213.103. If the person making the examination considers it to be necessary in the interest of safety, operating speed over the disturbed segment of track must be

reduced to a speed that he considers safe.

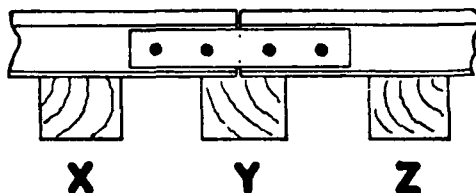
§ 213.109 Crossties.

(a) Crossties may be made of any material to which rails can be securely fastened. The material must be capable of holding the rails to gage within the limits prescribed in § 213.53(b) and distributing the load from the rails to the ballast section.

(b) A timber crosstie is considered to be defective when it is—

- (1) Broken through;
- (2) Split or otherwise impaired to the extent it will not hold spikes or will allow the ballast to work through;
- (3) So deteriorated that the tie plate or base of rail can move laterally more than one-half inch relative to the crosstie;
- (4) Cut by the tie plate through more than 40 percent of its thickness; or

SUPPORTED JOINT



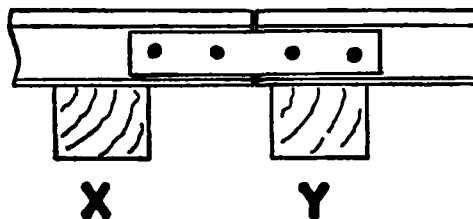
(5) Not spiked as required by § 213.127.

(c) If timber crossties are used, each 39 feet of track must be supported by nondefective ties as set forth in the following table:

Class of track	Minimum number of nondefective ties per 39 feet of track	Maximum distance between nondefective ties (center to center) (inches)
1.....	5	100
2, 3.....	8	70
4, 5.....	12	48
6.....	14	48

(d) If timber ties are used, the minimum number of nondefective ties under a rail joint and their relative positions under the joint are described in the following chart. The letters in the chart correspond to letters underneath the ties for each type of joint depicted.

SUSPENDED JOINT



Class of track	Minimum number of nondefective ties under a joint	Required position of nondefective ties	
		Supported joint	Suspended joint
1.....	1.....	X, Y, or Z.....	X or Y.
2, 3.....	1.....	Y.....	X or Y.
4, 5, 6.....	2.....	X and Y, or Y and Z.	X and Y.

(e) Except in an emergency or for a temporary installation of not more than 6-months duration, crossties may not be interlaced to take the place of switch ties. [36 FR 20336, Oct. 20, 1971, as amended at 38 FR 875, Jan. 5, 1973]

§ 213.113 Defective rails.

(a) When an owner of track to which this part applies learns, through inspection or otherwise, that a rail in that track

contains any of the defects listed in the following table, a person designated under § 213.7 shall determine whether or not the track may continue in use. If he determines that the track may continue in use, operation over the defective rail is not permitted until—

- (1) The rail is replaced; or
- (2) The remedial action prescribed in the table is initiated:

REMEDIAL ACTION

Defect	Length of defect (inch)		Percent of railhead cross-sectional area weakened by defect		If defective rail is not replaced, take the remedial action prescribed in note—
	More than	But not more than	Less than	But not less than	
Transverse fissure			20	100	B.
				20	B.
				100	A.
Compound fissure			20	100	B.
				20	B.
				100	A.
Detail fracture			20		C.
Engine burn fracture			100	20	D.
Defective weld				100	A, or E and H
Horizontal split head	0	2			H and F
	2	4			I and G.
	4				B.
Vertical split head	(Break out in railhead)				A.
Split web	0	1/2			H and F.
Piped rail	1/2	3			I and G.
Head web separation	0	3			B.
	(Break out in railhead)				A.
	0	1/2			H and F.
Bolt hole crack	1/2	1 1/2			I and G.
	1 1/2				B.
	(Break out in railhead)				A.
Broken base	0	6			E and I.
Ordinary break	0				(Replace rail).
Damaged rail					A or E.
					C.

NOTE.

- A—Assign person designated under § 213.7 to visually supervise each operation over defective rail.
- B—Limit operating speed to 10 m.p.h. over defective rail.
- C—Apply joint bars bolted only through the outermost holes to defect within 20 days after it is determined to continue the track in use. In the case of classes 3 through 6 track, limit operating speed over defective rail to 30 m.p.h. until angle bars are applied; thereafter, limit speed to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.
- D—Apply joint bars bolted only through the outermost holes to defect within 10 days after it is determined to continue the track in use. Limit operating speed over defective rail to 10 m.p.h. until angle bars are applied; thereafter, limit speed to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.
- E—Apply joint bars to defect and bolt in accordance with § 213.121 (d) and (e).
- F—Inspect rail 30 days after it is determined to continue the track in use.
- G—Inspect rail 30 days after it is determined to continue the track in use.
- H—Limit operating speed over defective rail to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.
- I—Limit operating speed over defective rail to 30 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.

(b) If a rail in classes 3 through 6 track or class 2 track on which passenger trains operate evidences any of the conditions listed in the following table, the remedial action prescribed in the table must be taken:

Condition	Remedial action	
	If a person designated under § 213.7 determines that condition requires rail to be replaced	If a person designated under § 213.7 determines that condition does not require rail to be replaced
Shelly spots	Limit speed to 20 m.p.h. and schedule the rail for replacement.	Inspect the rail for internal defects at intervals of not more than every 12 months.
Head checks	do	Inspect the rail at intervals of not more than every 6 months.
Engine burn (but not fracture)	do	
Mill defect	do	
Flaking	do	
Slivered	do	
Corrugated	do	
Corroded	do	

(c) As used in this section—

(1) "Transverse Fissure" means a progressive crosswise fracture starting from a crystalline center or nucleus inside the head from which it spreads outward as a smooth, bright, or dark, round or oval surface substantially at a right angle to the length of the rail. The distinguishing features of a transverse fissure from other types of fractures or defects are the crystalline center or nucleus and the nearly smooth surface of the development which surrounds it.

(2) "Compound Fissure" means a progressive fracture originating in a horizontal split head which turns up or down in the head of the rail as a smooth, bright, or dark surface progressing until substantially at a right angle to the length of the rail. Compound fissures require examination of both faces of the fracture to locate the horizontal split head from which they originate.

(3) "Horizontal Split Head" means a horizontal progressive defect originating inside of the rail head, usually one-quarter inch or more below the running surface and progressing horizontally in all directions, and generally accompanied by a flat spot on the running surface. The defect appears as a crack lengthwise of the rail when it reaches the side of the rail head.

(4) "Vertical Split Head" means a vertical split through or near the middle of the head, and extending into or through it. A crack or rust streak may show under the head close to the web or pieces may be split off the side of the head.

(5) "Split Web" means a lengthwise crack along the side of the web and extending into or through it.

(6) "Piped Rail" means a vertical split in a rail, usually in the web, due to failure of the sides of the shrinkage cavity in the ingot to unite in rolling.

(7) "Broken Base" means any break in the base of a rail.

(8) "Detail Fracture" means a progressive fracture originating at or near the surface of the rail head. These fractures should not be confused with transverse fissures, compound fissures, or other defects which have internal origins. Detail fractures may arise from shelly spots, head checks, or flaking.

(9) "Engine Burn Fracture" means a progressive fracture originating in spots where driving wheels have slipped on top of the rail head. In developing downward they frequently resemble the compound or even transverse fissure with which they should not be confused or classified.

(10) "Ordinary Break" means a partial or complete break in which there is no sign of a fissure, and in which none of the other defects described in this paragraph are found.

(11) "Damaged rail" means any rail broken or injured by wrecks, broken, flat, or unbalanced wheels, slipping, or similar causes.

(12) "Shelly spots" means a condition where a thin (usually three-eighths inch in depth or less) shell-like piece of surface metal becomes separated from the parent metal in the railhead, generally at the gage corner. It may be evidenced by a black spot appearing on the railhead over the zone of separation or a piece of metal breaking out completely,

leaving a shallow cavity in the railhead. In the case of a small shell there may be no surface evidence, the existence of the shell being apparent only after the rail is broken or sectioned.

(13) "Head checks" mean hair fine cracks which appear in the gage corner of the rail head, at any angle with the length of the rail. When not readily visible the presence of the checks may often be detected by the raspy feeling of their sharp edges.

(14) "Flaking" means small shallow flakes of surface metal generally not more than one-quarter inch in length or width break out of the gage corner of the railhead.

[38 FR 20336 Oct. 20, 1971, as amended at 38 FR 875, Jan. 5, 1973; 38 FR 1508, Jan. 15, 1973]

§ 213.115 Rail end mismatch.

Any mismatch of rails at joints may not be more than that prescribed by the following table:

Class of track	Any mismatch of rails at joints may not be more than the following—	
	On the tread of the rail ends (inch)	On the gage side of the rail ends (inch)
1.....	$\frac{1}{4}$	$\frac{1}{4}$
2.....	$\frac{1}{4}$	$\frac{3}{16}$
3.....	$\frac{3}{16}$	$\frac{3}{16}$
4, 5.....	$\frac{3}{16}$	$\frac{3}{16}$
6.....	$\frac{3}{16}$	$\frac{3}{16}$

§ 213.117 Rail end batter.

(a) Rail end batter is the depth of depression at one-half inch from the rail end. It is measured by placing an 18-inch straightedge on the tread on the rail end, without bridging the joint, and measuring the distance between the bottom of the straightedge and the top of the rail at one-half inch from the rail end.

(b) Rail end batter may not be more than that prescribed by the following table:

Class of track	Rail end batter may not be more than— (inch)
1.....	$\frac{1}{2}$
2.....	$\frac{3}{4}$
3.....	$\frac{3}{4}$
4.....	$\frac{1}{4}$
5.....	$\frac{1}{4}$
6.....	$\frac{1}{4}$

§ 213.119 Continuous welded rail.

(a) When continuous welded rail is being installed, it must be installed at, or adjusted for, a rail temperature range

that should not result in compressive or tensile forces that will produce lateral displacement of the track or pulling apart of rail ends or welds.

(b) After continuous welded rail has been installed it should not be disturbed at rail temperatures higher than its installation or adjusted installation temperature.

§ 213.121 Rail joints.

(a) Each rail joint, insulated joint, and composite joint must be of the proper design and dimensions for the rail or which it is applied.

(b) If a joint bar on classes 3 through 6 track is cracked, broken, or because of wear allows vertical movement of either rail when all bolts are tight, it must be replaced.

(c) If a joint bar is cracked or broken between the middle two bolt holes it must be replaced.

(d) In the case of conventional jointed track, each rail must be bolted with at least two bolts at each joint in classes 2 through 6 track, and with at least one bolt in class 1 track.

(e) In the case of continuous welded rail track, each rail must be bolted with at least two bolts at each joint.

(f) Each joint bar must be held in position by track bolts tightened to allow the joint bar to firmly support the abutting rail ends and to allow longitudinal movement of the rail in the joint to accommodate expansion and contraction due to temperature variations. When out-of-face, no-slip, joint-to-rail contact exists by design, the requirements of this paragraph do not apply. Those locations are considered to be continuous welded rail track and must meet all the requirements for continuous welded rail track prescribed in this part.

(g) No rail or angle bar having a torch cut or burned bolt hole may be used in classes 3 through 6 track.

§ 213.123 Tie plates.

(a) In classes 3 through 6 track where timber cross-ties are in use there must be tie plates under the running rails on at least eight of any 10 consecutive ties.

(b) Tie plates having shoulders must be placed so that no part of the shoulder is under the base of the rail.

§ 213.125 Rail anchoring.

Longitudinal rail movement must be effectively controlled. If rail anchors

which bear on the sides of ties are used for this purpose, they must be on the same side of the tie on both rails.

§ 213.127 Track spikes.

(a) When conventional track is used with timber ties and cut track spikes, the rails must be spiked to the ties with at least one line-holding spike on the gage side and one line-holding spike on the field side. The total number of track spikes per rail per tie, including plate-holding spikes, must be at least the number prescribed in the following table:

MINIMUM NUMBER OF TRACK SPIKES PER RAIL PER TIE, INCLUDING PLATE-HOLDING SPIKES

Class of track	Tangent track and curved track with not more than 2° of curvature	Curved track with more than 2° but not more than 4° of curvature	Curved track with more than 4° but not more than 6° of curvature	Curved track with more than 6° of curvature
1	2	2	2	2
2	2	2	2	3
3	2	2	2	3
4	2	2	3	3
5	2	2	3	3
6	2	2	3	3

(b) A tie that does not meet the requirements of paragraph (a) of this section is considered to be defective for the purposes of § 213.109(b).

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973]

§ 213.129 Track shims.

(a) If track does not meet the geometric standards in Subpart C of this part and working of ballast is not possible due to weather or other natural conditions, track shims may be installed to correct the deficiencies. If shims are used, they must be removed and the track resurfaced as soon as weather and other natural conditions permit.

(b) When shims are used they must be—

- (1) At least the size of the tie plate;
- (2) Inserted directly on top of the tie, beneath the rail and tie plate;
- (3) Spiked directly to the tie with spikes which penetrate the tie at least 4 inches.

(c) When a rail is shimmed more than 1½ inches, it must be securely braced on at least every third tie for the full length of the shimming.

(d) When a rail is shimmed more than 2 inches a combination of shims and 2-

inch or 4-inch planks, as the case may be, must be used with the shims on top of the planks.

§ 213.131 Planks used in shimming.

(a) Planks used in shimming must be at least as wide as the tie plates, but in no case less than 5½ inches wide. Whenever possible they must extend the full length of the tie. If a plank is shorter than the tie, it must be at least 3 feet long and its outer end must be flush with the end of the tie.

(b) When planks are used in shimming on uneven ties, or if the two rails being shimmed heave unevenly, additional shims may be placed between the ties and planks under the rails to compensate for the unevenness.

(c) Planks must be nailed to the ties with at least four 8-inch wire spikes. Before spiking the rails or shim braces, planks must be bored with ⅝-inch holes.

§ 213.133 Turnouts and track crossings generally.

(a) In turnouts and track crossings, the fastenings must be intact and maintained so as to keep the components securely in place. Also, each switch, frog, and guard rail must be kept free of obstructions that may interfere with the passage of wheels.

(b) Classes 4 through 6 track must be equipped with rail anchors through and on each side of track crossings and turnouts, to restrain rail movement affecting the position of switch points and frogs.

(c) Each flangeway at turnouts and track crossings must be at least 1½ inches wide.

[36 FR 20338, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973]

§ 213.135 Switches.

(a) Each stock rail must be securely seated in switch plates, but care must be used to avoid canting the rail by over-tightening the rail braces.

(b) Each switch point must fit its stock rail properly, with the switch stand in either of its closed positions to allow wheels to pass the switch point. Lateral and vertical movement of a stock rail in the switch plates or of a switch plate on a tie must not adversely affect the fit of the switch point to the stock rail.

(c) Each switch must be maintained so that the outer edge of the wheel tread

cannot contact the gage side of the stock rail.

(d) The heel of each switch rail must be secure and the bolts in each heel must be kept tight.

(e) Each switch stand and connecting rod must be securely fastened and operable without excessive lost motion.

(f) Each throw lever must be maintained so that it cannot be operated with the lock or keeper in place.

(g) Each switch position indicator must be clearly visible at all times.

(h) Unusually chipped or worn switch points must be repaired or replaced. Metal flow must be removed to insure proper closure.

§ 213.137 Frogs.

(a) The flangeway depth measured from a plane across the wheel-bearing area of a frog on class 1 track may not be less than 1¾ inches, or less than 1½ inches on classes 2 through 6 track.

(b) If a frog point is chipped, broken, or worn more than five-eighths inch down and 6 inches back, operating speed over that frog may not be more than 10 miles per hour.

(c) If the tread portion of a frog casting is worn down more than three-eighths inch below the original contour, operating speed over that frog may not be more than 10 miles per hour.

§ 213.139 Spring rail frogs.

(a) The outer edge of a wheel tread may not contact the gage side of a spring wing rail.

(b) The toe of each wing rail must be solidly tamped and fully and tightly bolted.

(c) Each frog with a bolt hole defect or head-web separation must be replaced.

(d) Each spring must have a tension sufficient to hold the wing rail against the point rail.

(e) The clearance between the hold-down housing and the horn may not be more than one-fourth of an inch.

§ 213.141 Self-guarded frogs.

(a) The raised guard on a self-guarded frog may not be worn more than three-eighths of an inch.

(b) If repairs are made to a self-guarded frog without removing it from service, the guarding face must be restored before rebuilding the point.

§ 213.143 Frog guard rails and guard faces; gage.

The guard check and guard face gages in frogs must be within the limits prescribed in the following table:

Class of track	Guard check gage	Guard face gage
	The distance between the gage line of a frog to the guard line ¹ of its guard rail or guarding face, measured across the track at right angles to the gage line, ² may not be less than—	The distance between guard lines, ¹ measured across the track at right angles to the gage line, ² may not be more than—
1.....	4' 6 $\frac{1}{2}$ "	4' 6 $\frac{1}{2}$ "
2.....	4' 6 $\frac{1}{2}$ "	4' 6 $\frac{1}{2}$ "
3, 4.....	4' 6 $\frac{1}{2}$ "	4' 6 $\frac{1}{2}$ "
5, 6.....	4' 6 $\frac{1}{2}$ "	4' 6"

¹ A line along that side of the flangeway which is nearer to the center of the track and at the same elevation as the gage line.

² A line $\frac{1}{4}$ inch below the top of the center line of the head of the running rail, or corresponding location of the tread portion of the track structure.

Subpart E—Track Appliances and Track-Related Devices

§ 213.201 Scope.

This subpart prescribes minimum requirements for certain track appliances and track-related devices.

§ 213.205 Derails.

(a) Each derail must be clearly visible. When in a locked position a derail must be free of any lost motion which would allow it to be operated without removing the lock.

(b) When the lever of a remotely controlled derail is operated and latched it must actuate the derail.

§ 213.207 Switch heaters.

The operation of a switch heater must not interfere with the proper operation of the switch or otherwise jeopardize the safety of railroad equipment.

Subpart F—Inspection

§ 213.231 Scope.

This subpart prescribes requirements for the frequency and manner of inspecting track to detect deviations from the standards prescribed in this part.

§ 213.233 Track inspections.

(a) All track must be inspected in accordance with the schedule prescribed

in paragraph (c) of this section by a person designated under § 213.7.

(b) Each inspection must be made on foot or by riding over the track in a vehicle at a speed that allows the person making the inspection to visually inspect the track structure for compliance with this part. However, mechanical or electrical inspection devices approved by the Federal Railroad Administrator may be used to supplement visual inspection. If a vehicle is used for visual inspection, the speed of the vehicle may not be more than 5 miles per hour when passing over track crossings, highway crossings, or switches.

(c) Each track inspection must be made in accordance with the following schedule:

Class of track	Type of track	Required frequency
1, 2, 3.....	Main track and sidings.	Weekly with at least 3 calendar days interval between inspections, or before use, if the track is used less than once a week, or twice weekly with at least 1 calendar day interval between inspections, if the track carries passenger trains or more than 10 million gross tons of traffic during the preceding calendar year.
1, 2, 3.....	Other than main track and sidings.	Monthly with at least 20 calendar days interval between inspections.
4, 5, 6.....		Twice weekly with at least 1 calendar day interval between inspections.

(d) If the person making the inspection finds a deviation from the requirements of this part, he shall immediately initiate remedial action.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973]

§ 213.235 Switch and track crossing inspections.

(a) Except as provided in paragraph (b) of this section, each switch and track crossing must be inspected on foot at least monthly.

(b) In the case of track that is used less than once a month, each switch and track crossing must be inspected on foot before it is used.

§ 213.237 Inspection of rail.

(a) In addition to the track inspections required by § 213.233, at least once a

year a continuous search for internal defects must be made of all jointed and welded rails in Classes 4 through 6 track, and Class 3 track over which passenger trains operate. However, in the case of a new rail, if before installation or within 6 months thereafter it is inductively or ultrasonically inspected over its entire length and all defects are removed, the next continuous search for internal defects need not be made until 3 years after that inspection.

(b) Inspection equipment must be capable of detecting defects between joint bars, in the area enclosed by joint bars.

(c) Each defective rail must be marked with a highly visible marking on both sides of the web and base.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973]

§ 213.239 Special inspections.

In the event of fire, flood, severe storm, or other occurrence which might have damaged track structure, a special inspection must be made of the track involved as soon as possible after the occurrence.

§ 213.241 Inspection records.

(a) Each owner of track to which this part applies shall keep a record of each inspection required to be performed on that track under this subpart.

(b) Each record of an inspection under §§ 213.233 and 213.235 shall be prepared on the day the inspection is made and signed by the person making the inspection. Records must specify the track inspected, date of inspection, location and nature of any deviation from the requirements of this part, and the remedial action taken by the person making the inspection. The owner shall retain each record at its division headquarters for at least 1 year after the inspection covered by the record.

(c) Rail inspection records must specify the date of inspection, the location, and nature of any internal rail defects found, and the remedial action taken and the date thereof. The owner shall retain a rail inspection record for at least 2 years after the inspection and for 1 year after remedial action is taken.

(d) Each owner required to keep inspection records under this section shall make those records available for inspection and copying by the Federal Railroad Administrator.

APPENDIX A—MAXIMUM ALLOWABLE OPERATING SPEEDS FOR CURVED TRACK

Degree of Curvature	Elevation of outer rail (Inches)											
	0	½	1	1½	2	2½	3	3½	4	4½	5	5½
Maximum allowable operating speed (mph)												
0°30'	93	100	107									
0°40'	80	87	93	98	103	109						
0°50'	72	78	83	88	93	97	101	106	110			
1°00'	66	71	76	80	85	89	93	96	100	104	107	110
1°15'	59	63	68	72	76	79	83	86	89	93	96	99
1°30'	54	58	62	66	69	72	76	79	82	85	87	90
1°45'	50	54	57	61	64	67	70	73	76	78	81	83
2°00'	46	50	54	57	60	63	66	68	71	73	76	78
2°15'	44	47	50	54	56	59	62	64	67	69	71	74
2°30'	41	45	48	51	54	56	59	61	63	66	68	70
2°45'	40	43	46	48	51	54	56	58	60	62	65	66
3°00'	38	41	44	46	49	51	54	56	58	60	62	64
3°15'	36	39	42	45	47	49	51	54	56	57	59	61
3°30'	35	38	40	43	45	47	50	52	54	55	57	59
3°45'	34	37	39	41	44	46	48	50	52	54	55	57
4°00'	33	35	38	40	42	44	46	48	50	52	54	55
4°30'	31	33	36	38	40	42	44	46	47	49	50	52
5°00'	29	32	34	36	38	40	41	43	45	46	48	49
5°30'	28	30	32	34	36	38	40	41	43	44	46	47
6°00'	27	29	31	33	35	36	38	39	41	42	44	45
6°30'	26	28	30	31	33	35	36	38	39	41	42	43
7°00'	25	27	29	30	32	34	35	36	38	39	40	42
8°00'	23	25	27	28	30	31	33	34	35	37	38	39
9°00'	22	24	25	27	28	30	31	32	33	35	36	37
10°00'	21	22	24	25	27	28	29	31	32	33	34	35
11°00'	20	21	23	24	26	27	28	29	30	31	32	33
12°00'	19	20	22	23	24	26	27	28	29	30	31	32

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973]

APPENDIX B

PROPOSED RAIL OUTLOADING PROCEDURE FOR A MOBILIZATION MOVE AT FORT CARSON

Maximum rail outloading operations use a cyclic schedule to minimize conflicts and improve control. The recommended outloading plan, Plan 5, is shown in Figure 38. All plans shown in the capability matrix (see Figure 25) follow the same basic idea, with greater outloading capability requiring more effort and greater cost.

The simulation begins with the assumption that it takes several days to accumulate the necessary number of railcars to start full-scale outloading operations. The switching locomotive positions the arriving railcars at the designated loadout sites according to a preconceived plan, at the same time, the equipment to be loaded aboard the cars is prepared and staged. Some personnel should be used to throw switches and act as road guards at all crossings to reduce delays, and insure a safer operation.

To understand more readily the simulation of Plan 5, Figure 39, the Kelker track assignment plan should be examined. The upper right of the figure shows Fort Carson track numbers with railcar capacity. Three trains of empties, with the Fort Carson track number and number of railcars, are shown in the lower left of the figure. The Kelker tracks and siding, with Kelker track number and Fort Carson corresponding number and capacity, are indicated in the center of the figure.

The operation proceeds as follows: Since all tracks on the installation hold loaded railcars, three trains of approximately 90 cars each are required to remove the cars; while the third train is being assembled, switching engines at Kelker are picking up empty cars to move to the loading sites. It should be noted that specific tracks at Kelker hold railcars for a specific track at Fort Carson. For instance, track 1 at Kelker holds 31 cars destined for track 4 at Fort Carson; these cars are to be picked up by train 3. To avoid confusion and to maintain an efficient operation, this procedure should be followed:

The cyclic schedule starts at 1400 hours, when the loaded cars at Fort Carson track 4 are pulled by main line locomotive 1 (C-31-L) and, at track 9, are pulled by main line locomotive 2 (C-9-L). Main line 2 must wait while main line 1 pulls the cars from tracks 5, 2, and 1 and departs for its destination. Main line 2 resumes at track 6 (C-40-L). Main line 3 comes in from Kelker and waits while main line 2 pulls track 7 (C-40-L) and departs. Main line 3 resumes and pulls cars from tracks 11, 10, 8, and 4. Main line 3 leaves at 1840 hours; all loaded cars have been removed.

Two switching engines have been waiting out of the way at Fort Carson track 12. To expedite train make up, switcher 2 proceeds to remove loaded cars from track 3 and place them on track 4. This is initiated at 1535 hours so they can be picked up by main line 3 (track 4 was pulled by main line 1). After moving 16 cars from track 3 to track 4 (8 cars per trip), since the "Y" will accommodate only eight 60-foot cars, switcher 2 proceeds to the south end of track 4 and waits. Switcher 1 then picks up the last four cars on track 3, places them on track 4, and proceeds back to track 3 to wait. This is completed at 1725 hours. These cars are picked up at 1840 hours, when switcher 2 transits to Kelker behind main line 3.

Meanwhile at Kelker, at 1810 hours, main line 4 arrives and couples with 80 empties on the siding (C-80-E), goes to Kelker, and waits for main line 3 to clear Kelker. Switcher 2 is at Kelker and couples with nine cars on Kelker track 4. Switcher 2 couples with main line 4, and this first train of empties proceeds to Fort Carson, with switcher 2 in front, at 1935 hours. At 2000 hours, switcher 2, with the nine cars for track 9, is uncoupled south of the passing track and goes to track 11 to get out of the way. Switcher 1 is on the passing track; it comes out onto the main track and couples onto the rest of the nine cars and pushes them into track 9. Main line 4, which had to wait for this maneuver, pushes the remaining 80 cars forward; 40 are dropped on track 7 and 40 on track 6. Main line 4 goes back to Kelker to begin making up another train of empties, and arrives at Kelker track 4 at 2130 hours. Switcher 2 puts the 40 cars on track 7 and track 6 into their final position. Switcher 1 transits to Kelker to assist main line 4 in making up the next train of empties. And the operation proceeds until all of the tracks at Fort Carson are again filled with 260 empty cars.

The simulation indicates that this should occur at 0345 hours the next day. The time for one complete cycle -- from 0700 hours, when loading commences, until 0345 hours the following day, when empties are again in position -- is 20 hours 45 minutes. This allows time for contingencies, such as placing cars on the wrong track, mechanical failure of equipment, and so forth, which are bound to occur in such a large continuous operation. The operating times used in the analysis are shown in Table IV.

Three locomotives, operating at Kelker and Fort Carson, are required for the operation, to switch and position empties, in addition to the locomotive power required to make up and remove three trains of loaded cars daily. The locomotive power to pick up loaded cars will be required about 5 hours (from 1400 to 1900 hours), and the engines for handling empties will be required approximately 12 hours (from 1530 to 0300) for two engines and 9-1/2 hours (from 1810 to 0300) for one engine per cycle.

LEGEND	
C	COUPLE
UC	UNCOUPLE
TR	TRANSIT
L	LOADED
E	EMPTY
39	NUMBER OF RAILCARS
(15)	TIME EXPENDED IN MINUTES
NO.4	TRACK LOCATION
MN	MAIN
TRK	TRACK
SB	SET BRAKES
WT	WAIT
K-1	TRACK NUMBER AT THE KELKER RAIL YARD
*	STRING OF RAILCARS NOT IN FINAL POSITION
SL #2	SWITCHING LOCOMOTIVE #2
ML	MAIN LINE LOCOMOTIVE

MAIN LINE LOCOMOTIVE #1	OPERATION	C-31-L	TR	C-22-L	TR	C-16-L	TR	
	TIME (MINUTES)	(15)	(10)	(15)	(10)	(15)	(10)	
	TRACK LOCATION	NO.4	NO.5	NO.5	NO.2	NO.2	NO.1	
	NUMBER OF RAILCARS	31	31	53	53	69	69	
MAIN LINE LOCOMOTIVE #2	OPERATION	C-9-L	WAIT					
	TIME (MINUTES)	(15)	(80)					
	TRACK LOCATION	NO.9	NO.9					
	NUMBER OF RAILCARS	9	9					
		MAIN LINE LOCOMOTIVE #3						
SWITCHING LOCOMOTIVE #1	OPERATION							
	TIME (MINUTES)							
	TRACK LOCATION							
	NUMBER OF RAILCARS							
SWITCHING LOCOMOTIVE #2	OPERATION	WAIT						
	TIME (MINUTES)	(100)						
	TRACK LOCATION	NO.12						
	NUMBER OF RAILCARS	0						

TIME IN HOURS

1400

1500

TIME IN HOURS 1400

1500

Figure 38. Rail Outloading Simulation, Plan 5.

TR	C 20-L	TR
(10)	(15)	(20)
NO. 1	NO. 1	KELKER
69	85	89

← LEAVES POST →

TR	C-40-L	WAIT	TR	C-40-L	TR
(10)	(15)	(10)	(10)	(15)	(20)
NO. 6	NO. 6	NO. 6	NO. 7	NO. 7	KELKER
9	49	49	49	89	89

← LEAVES POST →

MAIN	OPERATION	C-80-E	TR	WAIT
LINE	TIME (MINUTES)	(40)	(10)	(30)
LOCO	TRACK LOCATION	K-1	K-2	K-2
#4	NUMBER OF RAILCARS	80	80	80

E TIVE #3	OPERATION	TR	WAIT	TR	C-15-L	TR	C-14-L	TR	C-33-L	TR	C-20-L	TR	← LEAVES POST →
	TIME (MINUTES)	(20)	(30)	(10)	(15)	(10)	(20)	(15)	(20)	(10)	(20)	(20)	
	TRACK LOCATION	NO. 1	NO. 1	NO. 11	NO. 11	NO. 10	NO. 10	NO. 8	NO. 8	NO. 4	NO. 4	KELKER	
	NUMBER OF RAILCARS	0	0	0	15	15	29	29	62	62	82	82	

WAIT	TR	C-4-L	TR	C-16 UC	WAIT
(165)	(5)	(15)	(10)	-L 20-L	(140)
NO. 12	NO. 3	NO. 3	NO. 4	NO. NO.	NO. 4
0	0	4	4	4 20 0	0

TR	C-8-L	TR	UC	TR	C-8-L	TR	C-8 UC	TR	WAIT	TR	TR	C-9-E
(10)	(15)	(10)	8-L (5)	(10)	(15)	(10)	-L 16-L (5) (5)	(5)	(95)	(20)	(5)	(20)
NO. 3	NO. 3	NO. 4	NO. 4	NO. 3	NO. 3	NO. 4	NO. NO. 4 4 4	NO. 4	NO. 4	KELKER	K-4	K-4
0	8	8	0	0	8	8	16 0 0	0	0	0	0	9

1600

1700

1800

1900

NO. OF BACK	TR	UC	TR	UC	TR	UC	TR	TR	C 31-E	TR	C-20-E	C-38-E	TR	UC	WAIT	TR	UC	T	UC	TR	UC	TR
	(5)	20-E	(15)	15-E	(10)	14-E	(25)	(5)	(20)	(20)	(20)	+SL	(20)	16-E	(20)	(10)	22-E	(10)	20-E	(10)	31-E	(20)
	NO. 5		NO. 11	(5)	NO. 10	(5)	KELKER	K-1	K-1	K-6	K-6	#2	NORTH OF PASS TRACK	(5)	NORTH OF PASS TRACK	NO. 5	NO. 1	NO. 1	(5)	NO. 4	NO. 4	KELKER
	49	29	29	14	14	10	0	0	31	31	51	K-6	89	73	73	51	51	31	31	0	0	0

WAIT	TR	C-8	TR	UC-8-E	TR	C-8	TR	UC-8-E	TR	C-4	TR	UC-4-E	TR	C-15	TR	UC-15-E	TR	C-14	TR	UC-14-E	WAIT	TR	C-16	TR	UC-16-E	WAIT	TR	C-20	TR	UC-20-E
(25)	(5)	-E	(5)	SB	(5)	-E	(5)	(SB)	(5)	-E	(5)	(SB)	(10)	(5)	(5)	(SB)	(5)	-E	(5)	(SB)	(10)	(5)	-E	(5)	(SB)	(15)	(5)	-E	(5)	(SB)
NO.	NO.	(5)	NO.	(10)	NO.	(5)	NO.	NO.3	NO.	NO.	NO.	(10)	NO.	NO.	NO.	(20)	NO.	NO.	NO.	NO.	NO.10	NO.	NO.	NO.	NO.2	NO.	NO.	NO.	NO.	NO.1
0	0	4	8	8	0	4	8	8	0	4	4	4	0	11	15	0	0	10	14	14	0	0	16	16	0	0	0	20	20	0

4

TR	UC	TR
0	31-E	(20)
0.4	NO. 4	KELKER
0	*0	0

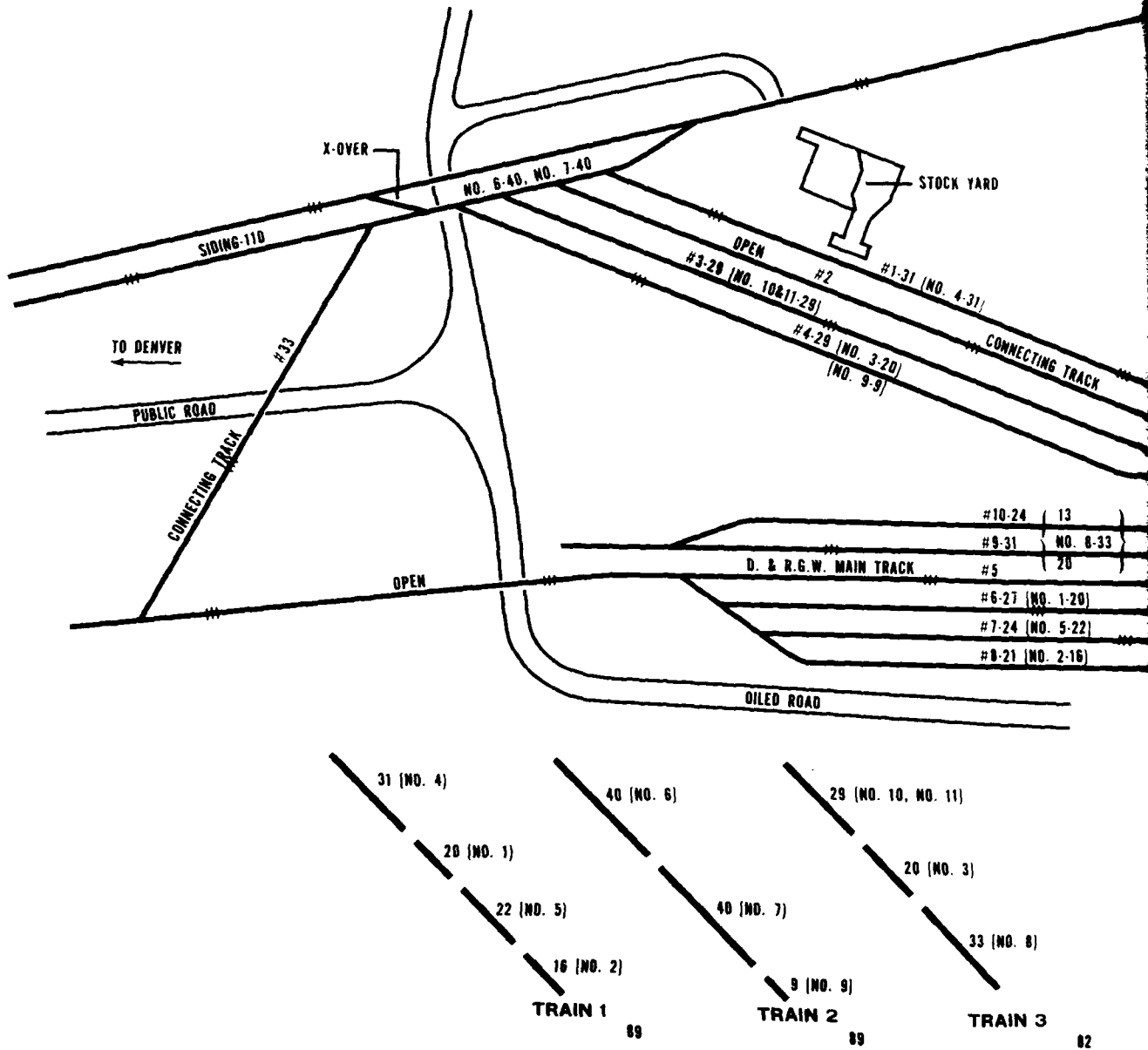
TR	C-20	TR	UC-20-E
(5)	E	(5)	(20)
(5)	(5)		
NO. 1	NO. 1		NO. 1
0	20	20	0

UC-22-E	TR	C-31	TR	UC-31-E
(SB)	(5)	E	(5)	(SB)
(20)	(5)	(5)		(20)
NO. 5	NO. 4	NO. 4	NO. 4	NO. 4
0	0	31	31	0

0300

0400

DWG. NO. 77-27



TRAINS WITH EMPTIES GOING IN TO POST FR

Figure 39. Track Assignment Plan, Kelker.

THE A.T. & S.F.R.R. CO'S MAIN TRACK

TRACK NO. FT. CARSON	1	2	3	4	5	6	7	8	9	10	11
CAPACITY RAILCARS 60' LG'S	20	16	20	31	22	40	40	33	9	14	15

LEGEND	
SYMB	DESCRIPTION
#	KELKER TRACK NUMBER
NO.	FT. CARSON TRACK NUMBER
C	COUPLE
UC	UNCUPLE
L	LOADED
E	EMPTY
TR	TRANSIT

TO PUEBLO

CONNECTING TRACK

NO. 24 (13)
 NO. 31 (NO. 8-33)
 NO. 27 (NO. 1-20)
 NO. 24 (NO. 5-22)
 NO. 21 (NO. 2-15)

#11

(NO. 8)

RAIN 3

82

TO FT. CARSON
 MATCH LINE

TO POST FROM KELKER

TABLE IV
TIMES REQUIRED FOR VARIOUS RAILCAR SWITCHING OPERATIONS

Empty

C-15-E (5 min)
C-30-E (10 min)
C-45-E (15 min)
UC-15-E (1-2 min)
UC-15-E (S.B.) (15 min)
UC-30-E (S.B.) (30 min) S.B = Set Brakes

Loaded

C-15-L (5 min)
C-30-L (10 min)
C-45-L (15 min)
But if cars have been sitting overnight
brakes must be checked
C-15-L (15 min)
C-30-L (30 min) (or 15 min for 2 men)
C-45-L (45 min) (or 15 min for 3 men)

Note:

Above times are for daylight operations, add 5 minutes
at night if brakes have to be set or checked.

TRANSIT SPEED

Average for all switching operations, 5 miles per hour.

APPENDIX C

SPECIAL-PURPOSE RAILCARS AND LOADING/UNLOADING PROCEDURES

Specially designed railcars, in particular those used for transporting vehicles, can greatly increase the speed and efficiency of a rail outloading operation. Bilevel, trilevel, and integral chain tiedown types of flatcars are the primary means of enhancing the loadout routine of most military vehicles. Bilevel and trilevel railcars are best suited for the smaller vehicles, including 2-1/2-ton trucks.

The integral tiedown flatcars will accommodate larger vehicles, including tanks. Loading and securing equipment on these railcars can be accelerated to 15 minutes per vehicle, for small vehicles, versus approximately 45 minutes for blocking and bracing procedures used on standard-type railcars. Also, the BTTX 89-foot flatcar has a capacity of six 2-1/2-ton trucks, doubling the single level capacity. Thus, in speed and capacity, special-purpose railcars are an advantage worth investigating.

There are essentially five methods of loading/unloading multilevel railcars, they are:

1. The "K" loader of the 463L aircraft cargo-loading system.
2. The forklift and pallet used in conjunction with a crane and/or ramp.
3. The crane and ramp combination.
4. Adjustable ramps.
5. Adjustable built-in ramp on multilevel railcars.

The procedures used with each of the above are described in detail in TM 55-625^{2/}, as are tiedown procedures.

As of 1970, more than 70 percent of DOD installations had no organic capability to load/unload multilevel railcars. No outloading plans should include the use of these railcars until a thorough investigation verifies their availability at the time required. The supply of special-purpose

^{2/} TM 55-625, Transportability Criteria and Guidance, Loading and Unloading Multilevel Railcars at Military Installations in the United States.

flatcars with integral tiedowns is also limited. As a result, even though these types of railcars are very valuable for volume rail outloading operations, their utilization is seriously in question unless advance preparations are made.

The following trends in flatcar supply are now operative and have been since the development of modern piggyback service in the mid-1950's:

1. The size of the flatcar fleet has been rising, both absolutely and relative to the size of the car fleet as a whole. This gain has been confined to specialized cars; for example, trailer-on-flatcar, container-on-flatcar, bilevel, trilevel, and bulkhead flatcars.
2. The size of the general-purpose flatcar fleet has decreased, though average length and capacity have increased.
3. A majority of all flatcars are owned by car companies, not by the railroads. While this makes for more flexibility in assignment, this flexibility has resulted in improved utilization. There are fewer idle cars available for short-notice use than there would be if each railroad had to maintain an adequate supply for its own needs.

Considering these trends, the size of the various components of the specialized flatcar fleet, and the blocking and bracing requirements of the various types of equipment to be shipped by rail, it does not appear prudent to express an installation's needs and outloading plan using only general purpose flats. The TOFC fleet especially is now large enough to make it likely that military requirements can be accommodated (see Table V). The COFC fleet has also expanded to the point that it could carry most of the military's container movements, especially if one considers that COFC cars are used almost exclusively for import/export movements, which are likely to be greatly disrupted in a mobilization period.

Accordingly, that portion of the outloading comprised of vans or containers should be planned for movement on TOFC cars. If the movement is to a port where ocean shipment will be by other than RORO vessel, the use of COFC cars should be discussed, though one cannot be confident of obtaining COFC cars in the quantity desired without disrupting civilian container movements.

Other cars in the specialized flatcar fleet are generally assigned to specific services or to a carpool for one shipper's exclusive use. Therefore,

TABLE V
TRAILER TRAIN COMPANY FLEET

Trailer Train Company ownership of selected car types as contained in the April 1976 Official Railway Equipment Register. Trailer Train owns in excess of 95 percent of total US ownership of TOFC, COFC, and auto rack cars.

Type	Reporting Marks	Quantity
TOFC	*TTX	29,661
	TTAX	5,033 (see also COFC cars)
	GTTX	2,287
	LTTX	1,876
	XTTX	733
	Total	39,580

These cars each have a capacity of two 40-foot (nominal length) trailers. Some can handle one 40-foot and one 45-foot trailer. The XTTX cars also have the capability of transporting three 28-foot trailers.

COFC	TTAX	5,003 (see also TOFC cars)
	TTCX	708
	Total	5,741

Each car can handle four 20-foot container equivalents. Note that the TTAX cars can handle either containers or trailers and so are counted in both TOFC and COFC totals.

Bilevels	TTBX	4,333
	BTXX	2,776
	Total	7,109
Trilevels	TTKX	6,133
	RTTX	3,500
	KTTX	2,685
	TTRX	2,196
	ETTX	796
	Total	15,310

*Definitions of Trailer Train Company's reporting marks (all are flatcars)

- TTX - Equipped with hitches and bridge plates for the transportation of trailers.
- TTAX - Equipped with movable foldaway container pedestals, knock-down hitches and bridge plates for transporting trailers or containers or combinations of both. (A = all).
- GTTX - Equipped with hitches and bridge plates for the transportation of trailers built by General American Transportation Corporation. (G = General)
- LTTX - Low deck (2' 8" or 2' 9" instead of 3' 6"), equipped with hitches and bridge plates. (L = Low)
- XTTX - Equipped with four hitches and bridge plates for the transportation of two trailers; one 45-foot and one 40-foot or three 28-foot trailers.
- TTCX - Equipped with movable foldaway container pedestals for transporting containers. (C = Container)
- BTXX - Equipped with bilevel auto racks furnished by member railroads. (B = bilevel)
- TTBX - Length 89' 4" or over, equipped with bilevel auto racks furnished by member railroads. (B = bilevel)
- TTKX - Length 89' 4" or over, equipped with hinged end trilevel auto racks furnished by member railroads.
- RTTX - Length 89' 4" or over, equipped with fixed trilevel auto racks furnished by member railroads.
- KTTX - Equipped with hinged end trilevel auto racks furnished by member railroads.
- TTRX - Equipped with fixed trilevel auto racks furnished by member railroads.
- ETTX - Equipped with fully enclosed trilevel auto racks furnished by member railroads. (E = enclosed).

while these cars can save blocking and bracing and should be requested at the time of a specific move to the extent they can be profitably employed, the likelihood of obtaining the cars is not such as to base outloading requirement on their use.

Factors affecting the use of specialized flatcars include:

1. First priority for use of general-purpose flats should be to load tracked vehicles and nonstandard wheeled vehicles; for example, artillery.

2. First priority for requesting specialized flats should be for TOFC and COFC cars to load vans and containers, which require very extensive blocking and bracing to move on general-purpose cars.
3. TOFC and COFC cars require no blocking and bracing.
4. Bilevel and trilevel flats will require heavier chains and possibly different hooks to handle other than commercial specification vehicles.
5. Chain tiedown flats may require heavier chains, depending on the loads for which they were designed.
6. Where TOFC cars must be loaded using a ramp rather than side or overhead loading, the number of cars at a ramp should be limited to about 10 because of the delay involved in backing the trailers down the length of the cars and returning with the tractor.
7. Where sufficient suitable aprons and MHE are available, it may be desirable to load containers directly onto COFC cars rather than place them on bogies and use TOFC cars.
8. If COFC or TOFC flats are not available, some blocking and bracing time and expense can be saved by using bulkhead flatcars to carry containers.
9. Bilevel and trilevel cars require, obviously, bilevel and trilevel ramps or other equipment as indicated in TM 55-625.
10. TOFC, COFC, bilevel, and trilevel cars average 89 feet long. TOFC cars can handle two 40-foot trailers or one 40-foot and one 45-foot trailer. COFC cars can handle four 20-foot container equivalents. Rack cars can accommodate four to seven vehicles per deck, depending on vehicle length and the number of tiedown chain sets.
11. Tracks used to store or load cars over 65 feet long should be reachable without going through curves exceeding 10-degree curvature; tracks used for cars between 55 and 65 feet should be reachable without going through curves exceeding 12-degree curvature.

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