Special Specification 2002
Ballasted Track Construction

1. DESCRIPTION

This Item will govern for the construction of ballasted track on constructed trackbed. Ballasted track construction includes, but is not limited to, placing ballast, distributing and lining ties, installing and field welding running rail, raising and lining track, and other incidentals as specified.

2. MATERIALS

2.1 **Rail.** Use Type RE 136 lb. Standard Strength Continuous Welded Rail meeting the requirements of Union Pacific Standard Drawing 176000, "136 Lb. Rail Section" and conforming to the requirements of American Railway Engineering and Maintenance of Way Association (AREMA) Chapter 4 "Rail." Rail on tangent track and on curves of 1° 30 min. or less must be new 136 RE standard carbon. Rail on curves greater than 1° 30 min. must be 136 RE head hardened rail. All rail, excluding rail for industry leads, must be continuously shop welded and transported in 400 ft. or longer sections to the project site or 39 ft. pieces trucked in and welded into the track using the flash butt weld process, unless shorter sections are required due to curve length, or fit between switches.

2.2 **Track Crossties.** Track crossties must conform to the current AREMA Specifications, Chapter 30, "Ties." The track crossties must be new Oak or Douglas Fir wood ties, 7 in. x 9 in. x 9 ft. minimum AREMA-7 in. Grade. Crossties must be treated according to the American Wood Preservers Association Standards, based on 50% creosote and 50% coal tar solution with a minimum preservative retention of 8 lb. per cu. ft. of wood. Crossties must be seasoned, dimensioned and prebored prior to treatment and treated in accordance with AWPA Standard C6 "Crossties and Switch Ties - Preservative Treatment by Pressure Processes," or ASTM D 1760 "Standard Specification for Pressure Treatment of Timber Products." All ties must be fitted with anti-splitting devices, regardless of their tendency to split.

Ties must be fabricated and preplated in accordance with Union Pacific Standard Drawing 0211H, "Preplating Dimensions for Wood Ties." Ties must be inspected and certified by an approved commercial testing laboratory stating that the ties to be used meet the specifications in accordance with AWPA Standard M2 "Standard for Inspection of Treated Wood Products." Results of test and inspections must be furnished to the Engineer.

2.3 **Tie Plates.** Hot worked, high carbon, double shoulder, flat bottom tie plates must conform to the AREMA specifications, Chapter 5, "Track," and Union Pacific Standard Drawing 0442D, "Double Shoulder Tie Plate for 6" Base Rail 1:40 Cant," with punched A-6 square spike holes.

Where necessary on curves, use Curve Block Assemblies in accordance with Union Pacific Railroad Standard Drawing 262000, "Curve Block Assembly."

2.4 **Track Spikes and Coach Screws.** Supply new high carbon steel track spikes conforming to the requirements of Union Pacific Standard Drawing 0451B, "Cut Spike for Wood Ties" and coach screws conforming to the requirements of Union Pacific Standard Drawing 130800, "Rectangular Head Timber Coach Screw." Track spikes and coach screws must meet the requirements of AREMA Chapter 5 "Track." Deliver track spikes to the Job Site in Engineer-approved containers (kegs). Install in accordance with Federal Railroad Administration (FRA) Standards.

2.5 **Joint Bars, Compromise Joint Bars and Track Bolts.** Use joint bars, compromise joint bars and track bolts conforming to the requirements of Union Pacific Standard Drawings 180100, "36," 6-Hole 136 Lb Joint Bar," 0904F, "Miscellaneous Joint Bars," 0948B, "Compromise Joints," and 0950H, "Track Bolt" and the

requirements of AREMA Chapter 4, Part 2, Section 2.8, "Specifications for Quenched Carbon-Steel Joint Bars, Microalloyed Joint Bars, and Forged Compromise Joint Bars." Compromise joint bars must be new and of the size, shape, and punch necessary to fit the rail sizes and sections being joined. Only factory designed and produced (forged or cast) compromise joint bars may be used to join rails of different sizes and sections.

2.6 **Rail Anchors.** Use Grip type rail anchors conforming to the requirements of Union Pacific Standard Drawing 0457A, "Heavy Duty Rail Anchor." Provide and Install in accordance with AREMA Chapter 5, Section 7 "Rail Anchors."

2.7 **Pipe Underdrains.** Pipe underdrains must be minimum 8 in. Class 1 corrugated steel pipe conforming to the provisions of AREMA Chapter 1, Section 4.3.

2.8 **Subballast.** Subballast must consist of a foundation coarse for a typical railroad roadbed and must be composed of crushed limestone or crushed concrete materials meeting Union Pacific Railroad Requirements and as approved by the Engineer. However, only 100% crushed material from oversized quarried rock or crushed concrete as the source will be accepted. Aggregate retained on a No. 10 sieve must consist of hard, durable particles or fragments of stone, gravel, sand or slag. Materials that break up when alternately frozen and thawed or wetted and dried are not permitted. Aggregate must not have a percentage of wear of more than 50%, by the Los Angeles abrasion test. A higher or lower percentage of wear may be specified by the Engineer, depending on the material available.

Subballast must be in accordance with Item 247 "Flexible Base."

- **Gradations.** Unless otherwise indicated on the plans, provide subballast consisting of gradations as set forth in Table 1.

Table 1
Subballast Gradations

Sieve Size	2"	1"	3/4"	No. 10	No. 40	No. 200
% Passing (optimum)	100	95	67	38	21	7
% Passing (permissible.)	100	85-100	50-85	16-50	12-30	0-16

2.9 **Ballast.** Railroad ballast material must be crushed granite stone in conformance with AREMA Chapter 1, Part 2. Ballast gradation must conform to AREMA Number 4.

3. PROPERTY REQUIREMENTS

3.1. **Physical Analysis**

3.1.1. **Method of Sampling.** Secure field samples in accordance with ASTM D-75. Reduce test samples from field samples in accordance with ASTM C 702.

3.1.2. **Sieve Analysis.** Perform sieve analysis in accordance with ASTM C 136. All sieve analyses require wet sieving.

3.1.3. **Material Finer than No. 200 Sieve.** Test material finer than a No. 200 Sieve in accordance with ASTM C 117.

3.1.4. **Bulk Specific Gravity and Absorption.** The minimum bulk specific gravity is 2.4. Determine bulk specific gravity and percentage of absorption in accordance with ASTM C 127.

3.1.5. **Percentage of Clay Lumps and Friable Particles.** Determine percentage of clay lumps and friable particles in accordance with ASTM C 142.

3.1.6. **Resistance to Degradation.** Determine the resistance to degradation in accordance with ASTM C 131 or C 535 as follows: test materials having gradations containing particles retained on the 1" sieve by ASTM C 535, test materials having gradations of 100% passing the 1" sieve by ASTM C 131.

3.1.7. **Sodium Sulfate Soundness.** Sodium sulfate soundness tests must be made in accordance with ASTM C 88.

3.1.8. **Unit Weight.** The weight per cu. ft. must be determined in accordance with ASTM C 29.

3.1.9. **Percentage of Flat or Elongated Particles.** Percent of flat or elongated particles must be determined in accordance with ASTM D4791.

3.1.10. **Plasticity Index.** The plastic limit, liquid limit and plasticity index must be determined in accordance with ASTM D 423 and D 424. Each sample must be tested in two ways; one test must test the fines generated by the Los Angeles Machine, and the other test must test the fines contained in the total sample. The portions of these samples generated by the Los Angeles Machine, and passing the #40 sieve must be non-plastic (NP). The portion of the total sample passing the #40 sieve must have a liquid limit of not more than 25, and plasticity index of not more than 6.

3.2. **Chemical Analysis.** No specific chemical analysis is considered essential for the evaluation of granite, trap rocks, or quartzite type materials, provided the materials are defined by applicable method.

For carbonate materials, dolomitic limestone is defined as having a magnesium carbonate content of 28 to 36%. Those carbonate materials indicating magnesium carbonate values above 36% must be defined dolomite. Carbonate material indicating magnesium carbonate values below 28% must be defined as limestone. Chemical analysis will be used in selecting or evaluating plant sites. Magnesium carbonate content of carbonate materials must be tested and defined in accordance with ASTM C 25.

The blending, stockpiling, and other production handling operations must be managed by the producer to minimize segregation of the finished product. Stockpiling operations must minimize, as practical, breakage or excessive fall in stockpiling operations and movement of wheeled or tracked machines over stockpile material must be limited. Processed ballast must be washed and rescreened as necessary to remove fine particle contamination as defined by the specification.

3.2.1. **Loading.** The manufacturer must ensure the fitness of the cars for loading of prepared materials, arranging to clean cars of deleterious materials, plug leaks, close doors, and other like operations as necessary.

3.2.2. **Inspection.** The Texas Department of Transportation (TxDOT) or its representative reserve the right to visit the producers facility during usual business hours unscheduled for the following purposes:

Prior to installation, the supplier should provide the Engineer with certified results of ballast quality and gradation as conducted by a testing laboratory acceptable to the Engineer. The supplier must receive approval from the Engineer for the testing laboratory prior to performing tests.

	UP BALLAST CLASS			
	1	2	3	SUB BALLAST
SQUARE OPENING	2"-3/4"	1"-3/8"	3/4"-0"	1 1/2"-0"
2 1/2"	100			
2"	90-100			
1 3/4"				
1 1/2"	60-90			
1 1/4"		100		100
1"	10-35	90-100	100	
3/4"	0-10	40-75	90-100	60-85
1/2"		15-35	20-55	
3/8"	0-3	0-15	0-10	15-45
No. 4		0-5	0-5	7-25
No. 8			0-1	0-10
No. 200	0-.5	0-.5	0-1	0-3

Percent Passing (By Weight) [All Aggregate Sampling and Testing Per ASTM Latest Revision]

4. GENERAL

4.1. **Requirements.** Before starting work, inform the Engineer of the proposed construction methods, the adequacy of which will be subject to the approval of the Engineer.

All on-track equipment used in connection with the project must comply with Federal Railroad Administration regulations contained in 49 CFR 214 Subpart D, Roadway Maintenance Machine Safety

Concurrence on the part of the Engineer of any proposed construction methods or approval of equipment does not relieve the Contractor of the responsibility for the safety or correctness of the methods, the adequacy of his equipment or from carrying out the work in full accordance with the contract.

The following codes, regulations, reference standards, and specifications apply to work included in this section:

- AREMA, Manual for Railway Engineering, Chapter 1 “Roadway and Ballast,” Chapter 4 “Rail” and Chapter 5 “Track.”
- American Welding Society (AWS): D1.1
- Applicable referenced ASTM Specifications
- Track Safety Standards of the Federal Railroad Administration (FRA).
- Union Pacific Railroad Company (UPRR) Technical Specifications for the Construction of Industrial Tracks and Track Standard Drawings.

Any Items not covered specifically in this specification must be in accordance with AREMA Standards and recommended practices subject to the approval of the Engineer. Construction must adhere to all UPRR Standard Plans and FRA requirements.

The following review/approval milestones will be monitored during the project:

- **Grading.** Reviewed and approved prior to placement of subballast.
- **Ballasted Trackwork.** Review, approve and coordinate the track construction to assure compliance with UPRR requirements.

- **Welding.** All welds, including compromise welds must be done in accordance with Union Pacific Railroad Company Requirements Governing the Inspection, Grinding, and Heat Treating of Track Components.

All workers employed in the project or supervising the project must be certified according to Federal Railroad Administration regulations contained in 49 CFR 214, Subpart C, Roadway Worker Protection.

When the Contractor desires to occupy any space above the top of rail within the horizontal distance of 12 ft. either side of the centerline of any track, measured at right angles to the track centerline, it will be necessary that he obtain authority from the Fort Worth & Western Railroad (FWWR) with at least 24 hr. advance notice. The authority will be requested and granted according to the FWWR operating rules, and the Contractor will fully comply with all instructions issued by the FWWR in regards to occupancy of the track. If, in the judgment of the FWWR, flagmen are required, they will be furnished at the FWWR's expense.

The Contractor will require his employees, agents, and subcontractors to comply with all instructions or warnings of the FWWR's flagmen as to clearance for the passage of trains.

All scaffolding, materials, and equipment used in the Contractor's operations must be maintained at all times at a clearance from the tracks as approved by the Engineer, except when working within the limits of authority granted to occupy the tracks.

TxDOT's acceptance of trackage and its appurtenances which have been built will be based on the Engineer's written statement that construction and construction materials have met TxDOT standards.

Unless otherwise specified by the plans or directed by the Engineer, all removed materials will become the property of the Contractor. All removed materials and debris must be removed from the railroad right of way and TxDOT property, and disposed of in a manner approved by the Engineer.

The replacement of railroad ties, ballast distribution, surfacing work, and associated mechanical operations will be performed using standard on-track equipment. All work must be performed using on-track equipment whenever possible.

Designated materials storage areas and mobilization areas must have SW3P plans implemented as shown in the plans before off-track equipment operates in those areas.

5. CONSTRUCTION

All trackwork must be constructed in accordance with the following:

5.1. **Subgrade.** Railroad subgrade must be constructed in a firm and unyielding manner and compacted to a minimum density of 95% modified proctor, regardless of the depth, except that all fill within 100 ft. of bridge ends and 20 ft. of outer edges of culverts must be compacted to 100%. Moisture content of fill material must be adjusted to within -3% and +3% of optimum moisture content prior to compaction. Subgrade stabilization must be in accordance with TxDOT's Standard Specification Item 260, "Lime Treatment (Road-Mixed)," to the lines, grades, and thickness as shown on the plans. If geotechnical report suggests other stabilization methods, the alternative method will be considered.

5.2. **Trackwork.** All ties must be spaced uniformly at 19.5 in. center-to-center of ties (24 crossties per 39 ft. of rail), and laid with heart side down, except when ties are not true, the bow side must be laid upward.

Ties must be placed and maintained square to the line of rail on straight track and radially on curves. The right-hand end of ties (direction determined by facing away from initial point of the line) must be lined parallel with the rail.

Tie hooks, tongs or tie crane must be used in handling ties, to avoid damage to the ties. New treated ties must not be adzed without authority from the Engineer. If adzing is authorized, an approved preservative must be applied to the adzed surface.

Tie plates must set squarely on the tie and must be of the dimensions to fit the base of rail used. All track must be fully tie plated and spiked in accordance with proper criteria. Tie plates must be centered and have full bearing on ties. Rail must be properly seated in the tie plates and not riding on the shoulder of the tie plate. Tie plates and rail must be cleaned before being laid. Tie plates must be placed with slope of plate towards center of track.

All rail must be gauged when laid. The standard gauge is 4 ft. 8-1/2 in. between points 5/8 in. below the top of rail on the two inside edges of the rail. All gauges used by the Contractor will be checked by the Engineer. If found to be more than 1/16 in. in variance from the master gauge, those gauges must immediately be removed from the job.

Track bolts, with nuts, which have wrench turn fittings, must be used where required. Spring washers must be the correct size to fit the bolt. All bolts will be tightened with an approved bolt machine or torque wrench to a torque of 650 ft.-lb. Bolting must be started with the center bolts working toward the ends and all nuts must be turned up tight with bolt heads staggered inside and outside of the rail alternately.

All track spikes are to be the proper size. Care must be taken to make sure that the base of rail is not riding on the shoulder of the tie plate when spikes are driven. Spikes must be started, driven vertically, and square when driven into the spike holes of the tie plate. Crooked or bent spikes must be removed and replaced. Straightening with maul of spikes started crooked will not be permitted. When spikes are pulled, the hole must be plugged with a standard treated tie plug. In driving the spikes, the last few blows of the hammers must be such that the spike head will not be bent or broken, and the hammer must not be permitted to strike directly upon the rail. All rail must be spiked to ties with not less than four spikes per tie, one spike in contact with gauge side and one in contact with field side of each rail.

Spikes must be staggered so that the outside spikes must be on the same side of the tie and the inside spikes on the opposite side.

Rail must not be struck with maul or heavy tool when spiking, gauging or lining.

Immediately after completion of track surfacing, spikes must be settled in place with the underside of the head of the spike contacting the top of base of rail with a minimum of pressure.

Tie plugs, where required, must fill holes from which spikes are drawn. The plugs must conform to the current AREMA Specifications for Tie Plugs, and are to be treated with a Creosote oil solution.

Grip type rail anchors must be applied by an approved rail anchor applicator machine and in the approved manner for the particular type of anchor furnished. Rail anchors must be installed after the ballast operation and the track is raised, lined and ties re-spaced. Under no circumstances will rail anchors be installed on ties under or immediately adjacent to rail joints, nor will anchors be installed on one side of the tie under one rail and on the opposite side of the tie under the other rail. Care must be taken to avoid overdriving or damaging anchors. Anchors must not be driven along the rail.

Sufficient rail anchors must be applied and maintained to effectively control longitudinal rail movement. Anchors must be installed on the same side(s) of the tie on both rails. Anchors must not be applied to one rail only, but must be applied to both rails in a uniform pattern. For continuously welded rail (CWR), anchors must not be applied on the opposite rail directly across from the joints or straps.

Track must be box anchored every other tie. Box anchoring is defined as installing opposing anchors to bear against each side of the tie on each rail for a total of four anchors per cross tie.

When laying rail in tangent track, the right-hand rail (direction determined by facing away from initial point of line), must be laid first and lined to the staked track alignment. After each right-hand rail is lined and spiked,

the left-hand rail must be laid to accurate gauge and spiked to gauge every third tie with gauge spikes fully driven (except through joint areas) before the track gauges are removed.

The left-hand rail must be laid into the track, and rail joint bolts installed (if used) before spiking to gauge, and before gauge spikes are driven. The left-hand rail must be held in place snugly against the track gauges with lining bars.

When laying up to existing track tie-in locations, a combination of rails less than standard length may be used to avoid cutting, if practicable. Rail saws must be used when necessary to cut rail. The use of a torch or track chisel will not be permitted. All necessary new bolt holes must be marked, using an approved rail drilling template and the drilling operation must be carefully performed. Utilize proper lubrication when cutting and drilling. Cut rails must be drilled and fully bolted. There must be no extra holes in the rail. Carefully remove the burred edges on bolt holes drilled in the field by grinding. When necessary to cut secondhand rail, the cut end must be beveled. When necessary to cut new standard carbon rail, the cut end must be end hardened and beveled in accordance with Railroad Specifications.

The desired laying temperature of the rail is 115°F. Record the temperature of each rail laid. Rail temperature measurements must be taken on the base of rail on the side away from the sun.

When it is not possible to lay rail at the desired laying temperature, make the necessary adjustment at a later date. The exact procedure used to adjust the rail temperature must be approved by the Engineer.

The Contractor should apply all rail anchors immediately behind the laying of CWR. Ballast must be unloaded and all cribs filled as soon as rail anchors have been applied. The track should be surfaced and tamped as soon as possible after the laying of the CWR.

De-stressing rail must conform with UPRR's Engineering Track Maintenance Field Manual, Sections 4.5.1, 4.5.5, 4.13, 7.8.1 and 7.8.2. Supply all field weld kit, molds, bentonite, sand, paste, etc., for Fort Worth & Western Railroad (FWWR) crews to use for cutovers. Welds will be Boute one-shot.

5.3. **Joint Bars.** At the time rail is being laid, joint bars must be applied, placing one bolt at each end of rail in the joint bar. Before the bolts are tightened, and after the track has been surfaced and lined, the joint bars must be removed and the joint bars as well as the rail ends within the limits of the joint bar area must be thoroughly cleaned with a wire brush to remove all rust, dirt and mill scale. The contact surface of the joint bars must then be lubricated using a liberal amount of lubricant as approved by the Engineer. After application of lubricant, the joint bars are to be reapplied; taking care to see that no dirt, gravel or other foreign material is permitted to get into the lubricated area.

5.4. **Staggering of Rail Joints.** Rail not in CWR locations must be staggered according to the Union Pacific Maintenance of Way Rules or at the direction of the Engineer, except when balancing the joints for switch leads, road crossings, bridge ends and signal circuits, as well as in secondary tracks where use of prefabricated track panels is authorized. To reduce the resonant reaction, rail joints must be staggered at 12 ft. from the nearest joint on the opposite rail. To avoid unnecessary rail cutting in providing staggered joints, a two-ft. tolerance will be permitted in either direction. When laying rail, joints must not be located in road crossings, bridge decks, or on ends of bridges.

5.5. **Rail Expansion Shims.** Expansion shims must be used to establish the proper opening between rails. At joints, the opening between rail ends must be as shown in the following table(s):

For 39 ft Rail:

Rail Temperature	Opening
Below 25° F	½"
51° F to 75° F	1/8"
Above 75° F	1/8" every other joint

For 78 ft Rail:

Rail Temperature	Opening
Below 25° F	½"
25° F to 50° F	3/8"
51° F to 75° F	1/4"
75° F to 100° F	1/8"
Above 100° F	1/8" every other joint

Rail thermometers of the approved type must be used to determine the rail temperature.

Exception: Expansion shims must not be used at the ends of strings when laying CWR.

5.6. **Joint Bar Lubrication**. The application of lubricants and general maintenance of rail joints in jointed-rail territory are necessary to ensure that the rail is working properly to accommodate rail expansion and contraction resulting from temperature variations, and prevent the occurrence of track buckles or sun kinks and pull-aparts. Joint bars and rail ends must be cleaned and lubricated with an approved joint lubricant when installing joint bars. Joints must be installed with the full number of bolts and the nuts tightened to the proper tension.

When laying new or second hand jointed rail, or constructing new track using jointed rail, the contact surface of the rail ends and joint bars must be lubricated using a liberal amount of approved lubricant.

To maintain free rail movement in existing joint rail territory, joint area must be thoroughly lubricated along all marring surfaces and into the interior of the bars, using a Hudson sprayer or equivalent. Frozen joint conditions must be corrected by loosening the bolts and breaking the bars free from the rail to permit proper oiling and ensure free rail movement within the joint.

5.7. **Mismatched Rail**. Where the running surface of rails at joints are mismatched by more than 1/8 in., build up, grind, and profile the rail per Union Pacific Railroad Company Instructions Governing the Inspection, Welding and Heat Treating of Track Components. A rail of more section must not be ground down to match the lesser, but the lesser built up.

5.8. **Compromised Joints**. At permanent connections of different rail sections, compromise joints or compromise welds must be installed in accordance with Union Pacific Railroad Track Standard Drawings, and where practicable must not be located in crossings, main track curves, on open deck bridges, or in turnouts.

Compromise Joints are required at all locations between the ends of rail of different weights or cross section. Install all compromise joints as directed by the Engineer. Installation of compromise joints will be considered incidental to track laying and no separate payment made therefore. Compromise joints must not be placed within the limits of turnouts.

6. BALLASTING AND SURFACING

Furnishing, delivery and unloading of ballast to project site is the Contractor's responsibility. Care must be taken to insure that track and walkways are safe for movement.

Haul and place ballast material in such a way that damage to adjacent areas is avoided.

Ballast must be uniformly distributed and the track raised, lined, surfaced, and tamped, with the finished surface of the ballast dressed in accordance with the approved drawings.

The track must be laid and connected before ballast is spread and raised. It will not be permissible to operate over long stretches of track before it has been raised and surfaced unless approved by the Engineer. Immediately prior to unloading ballast for the final 4 in. raise, the track must be lined as close as practical to the stakes and all ties straightened and respaced as necessary. Ballast must then be spread evenly and leveled to the required section, taking care to assure that subgrade material is not intermixed with the ballast.

Ballast must be spread and the track raised in a series of lifts to the approved elevation. No single lift must be higher than 4 in. In raising track, if jacks or mechanical tampers are used they must be so regulated as to avoid the binding or straining of joints. Sufficient sets of track jacks, if used, must be simultaneously used and properly spaced to avoid sharp breaks or bends in the rail when the track is raised. Both rails must be raised simultaneously and to proper cross level by utilizing standard track level boards with each set of track raising jacks (minimum three insertions). Tamping is to be done by a Jackson 6700 or approved equivalent in a manner that will produce uniform compaction. Tamping must not disturb subgrade/subballast. Thorough tamping under the rail set is required, and joint ties must be tamped especially firm. Tamping will not be permitted at the middle of a tie. Both ends of a tie must be tamped simultaneously and tamping inside and outside the rail must be done at the same time. All ties that are pulled loose in the track raising operation must be placed in their proper position and properly tie-plated and fully spiked before tamping. The track must be true to line and grade as staked with tangent track level transversely. During each track raise, the track is to be tamped in such a manner that it will be uniform.

During the raising and tamping operations, sufficient spot boards, track level boards or other approved surfacing devices must be constantly used to insure the correct surface and cross level in the track after tamping work is completed. After ballasting is completed and the track is in correct gauge, surfaced and lined according to the stakes, the ballast must be trimmed neatly to the section shown on the drawings, and any surplus material must be spread evenly along the slopes of the ballast section. Dressing of the ballast by placing earth higher than the ballast toe and thus preventing proper drainage will not be permitted.

Bring the initial layer of compacted ballast to an elevation that will establish the track surface no higher than 2 in. below final base of rail grade. Refer to plans and cross sections for ballast depth and base of rail grades.

Ballast must be inserted under ties in minimum 2-1/2 in., maximum 4 in. lifts. Cribs must be filled with ballast to the top of tie.

Do not perform track surfacing unless the cribs are filled with ballast.

Special care must be taken when surfacing during hot weather in order to avoid track buckles.

Perform track surfacing by an approved method which prevents undue bending of the rail or straining of the joints.

Both rails must be raised at one time and as uniformly as possible.

Ties that have been pulled loose must be replaced to proper position and must be fully tamped to proper elevation.

Ballast must be kept clean and free of segregation during handling and placing operations.

Ballast to be thoroughly tamped from each tie end to 15 in. outside and inside of rail. Centers are to be filled but not tamped.

Tamping tools must be inserted simultaneously on opposite sides of the same tie to prevent the tie from cocking, to insure that the ballast under the tie is completely compacted and that the rail is firmly seated on the tie plate.

When using power tampers in tandem, the machines should be of the same type and have identical tamping heads to produce uniform compaction.

Track must be constructed to the alignment and grade prescribed by the plans. Deviation from established gauge and cross level must not exceed 1/4 in.; deviation from profile grade and horizontal alignment must not exceed 1/4 in. in 50 ft.. All work must be acceptable to the Engineer.

Tangent track must be cross level.

No humps or sags will be accepted nor will irregularities in alignment, either on tangent or curved track, that exceed previously defined deviations.

Maximum allowable adjustment in line after final resurfacing is 2 in..

Top of track ballast must be dressed parallel with top of ties, extending 12 in. beyond the end of tie, then on three to one slope to subballast. Not less than three insertions of tamping tools must be made.

Before final acceptance, all track must be surfaced and accurately lined to remove all irregularities of cross level, surface or line caused by settlement or compaction of ballast following traffic loading. Any ties not giving full support to rails must be retamped. Bolts must be retightened, if necessary, to bring to full tension and spikes set down to full rail contact.

The FWWR's acceptance of trackage and its appurtenances which have been built must be based on the FWWR's Representative's written statement that construction and construction materials have met FWWR standards.

7. FIELD RAIL WELDING

All field welding must be performed in accordance with the following:

Clean the rails to be free of grease, oil, dirt, loose scale, and moisture to a minimum of 6 in. back from the rail ends, including the rail end surfaces, by use of a wire brush. Align the faces of the rail ends. Rail ends to show no steel defects, dents, or porosity before welding. If rail must be cut to length for any reason, cut it square and clean by means of rail saws or abrasive cutting wheels in accordance with AREMA, "Specifications for Steel Rails." Straighten rail not meeting the requirements of AREMA, "Specifications For Fabrication of Continuous Welded Rail," to be within the specified tolerance. If any rail cannot be straightened, cut it back a sufficient distance to achieve the required alignment. Perform all straightening or cutting prior to welding. Align and properly gap the ends of the rails to be welded to produce a weld which conforms to the alignment tolerances specified.

Hold the rail gap and alignment during field welding without change during the complete welding cycle. Align rail on the head of the rail. Vertical alignment must provide for a flat running surface. Horizontal alignment must be in such a manner that any difference in the width of heads of rails occurs on the field side. Horizontal offsets must not exceed 0.040 in. in the head and 0.125 in. in the base. Surface misalignment tolerance must conform to the following:

- **Combined Vertical Offset and Crown Camber.** Not to exceed 0.080 in. per ft. at 600°F or less. No dip camber will be allowed.

- **Gauge Misalignment Tolerance.** Combined horizontal offset and horizontal kink camber not to exceed 0.080 in. per ft. at 600°F or less.

All rails for electric-flash butt welds must have the scale removed down to the bright metal in those end zones, top and bottom of the rails where the welding current-carrying electrodes contact on head and base of rail. All electric-flash butt welds must be forged to point of refusal to further plastic deformation and have a minimum upset of 1/2 in., with 5/8 in. as standard. If flashing on electric-flash butt welds is interrupted because of malfunction or external reason, with less than 1/2 in. of flashing distance remaining before upsetting, rails must be reclamped in the machine and flashing initiated again. Rails for preheated rail welds must be cleaned 2 in. on each side of the weld, to remove scale and rust using a power actuated grinder, with abrasive wheel.

Rail ends must be preheated prior to welding to at least the temperature designed by the welding manufacturer and for a sufficient time to ensure full fusion of the weld metal to the rail ends without cracking of the rail or weld.

Inspect each weld using a 3 ft. straightedge along the centerline of the rail and 0.625 in. below top of rail on the gauge side of the rail head. Center the straightedge over the weld. The gap between the straightedge and the rail to comply with the requirements of AREMA, Chapter 4 and the Union Pacific Railroad Company Instructions Governing the Inspection, Grinding and Heat Treating of Track Components.

Bring rails and joints in the finished track to a true surface and alignment by means of an approved grinding machine.

If end bolt hole is drilled in rail to be welded, the minimum allowable distance from end of rail to edge of end bolt hole is 6."

Finish the completed weld by grinding to conform with the following requirements:

- Rail head surface and sides must be finished ground to a smooth and uniform surface.
- The web zone (underside of head, web, top of base, both fillets each side) must be finished to not greater than 1/8 in. of parent contour or closer, but must not be deeper than parent section. Finishing must eliminate all cracks.
- All notches created by offset conditions or twisted rails must be eliminated by grinding to blend the variations.
- All fins on the weld due to shearing drag must be removed prior to final inspection.
- All heavy grinding must be performed on the hot metal, immediately following welding, by an approved rail grinder, to prevent metallurgical damage. Finish grinding must be carried out in a cooled down condition. Use a straightedge frequently while grinding to make sure that a good straight surface is produced. If a hard grinder must be used, extra care must be taken to insure a smooth running surface without low spots. Any grinding of the web and base of the weld should be done while the web is at least 450°F.
- Jagged, notched or badly mismatched end faces must be preflashed to an even or mated condition before setting up rails for preheating and final flashing to assure that the entire surfaces of the rail ends are uniformly flashing immediately preceding upsetting.

Test all welds at the time of welding and ultrasonically test both the welds and the rail once the rails have been laid in final position. Ultrasonically inspect welds in accordance with ASTM E164 and the AWS D1.1. Use ultrasonic test equipment capable of detecting a 3/64 in. discontinuity, 6-1/2 in. below the top of rail. At a minimum, scan the weld from the top and both sides of the rail head and the base. Scan the weld from both sides on the face for longitudinal and transverse discontinuities using the applicable scanning pattern or patterns. Use equipment which has a distance amplitude correction feature. Calibrate the equipment daily using an 11 W calibration block, also made of rail steel.

Inspection Personnel: Qualify all inspection personnel in accordance with AWS D1.1. Cut out and re-weld all welds giving fault indication in ultrasonic inspection.

De-stressing rail must conform with UPRR's Engineering Track Maintenance Field Manual, Sections 4.5.1, 4.5.5, 4.13, 7.8.1 and 7.8.2. Supply all field weld kit, molds, bentonite, sand, paste, etc., for FWWR crews to use for cutovers. Welds will be Boute one-shot.

8. MEASUREMENT

Ballasted Track Construction will be measured by the track foot for construction.

Track Removal will be measured by the track foot for removal.

Subballast will be measured by the cu. yd. complete in place.

9. PAYMENT

The work performed and material furnished by this Item and measured as provided under "Measurement," will be paid for as follows:

Payment for ballasted track (installed by FWWR) will be made utilizing the Railroad Force Account "Railroad Trackwork." This price will be full compensation for furnishing, transporting, storing, installing of materials including track rail, all welding, and placing ballast; for raising track to final grade and alignment; and for all other materials, tools, equipment and incidentals necessary to complete the work.

Payment for Track Removal (performed by FWWR) will be made utilizing the Railroad Force Account "Railroad Trackwork." This price will be full compensation for removing the existing track and for all other materials, tools, equipment and incidentals necessary to complete the work.

Payment for subballast will be at the unit price bid for "Subballast." This price will be full compensation for furnishing, hauling, placing, sprinkling, rolling the subballast and for all other materials, tools, equipment and incidentals necessary to complete the work.