# Federal Railroad Administration

# Track and Rail & Infrastructure Integrity Compliance Manual

## Volume I, Chapter 3
## Automated Track Inspection Program (ATIP) Geometry Car Operation

March 2018

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## March 2018 Release Note (Volume I, Chapter 3):

Reprint of the January 2014 release. There are no changes.

# CHAPTER 3

## Track Geometry Inspection Car Operation

### *Background*

This chapter provides functional understanding of the Automated Track Inspection Program (ATIP) in terms of operation, policy, on-track safety requirements, geometry measurement technology, and national deployment of the FRA rail bound inspection cars. Under the statutes mandated by Congress, ATIP cars conduct operational surveys of the U.S. rail transportation network for the singular safety function of determining railroad compliance with Federal Track Safety Standards (TSS). Since 1974, the operation of ATIP cars serves an important role in FRA's overall compliance programs. FRA's Office of Railroad Safety manages the program, and logistic support is provided under a contract.

### *ATIP Track Geometry Inspection Car Operation*

All FRA Inspectors assigned to ATIP cars are to ensure applicable compliance with railroad operating rules, special instructions, and specific FRA policy and procedures by everyone on board when ATIP geometry cars are operated.

The seven ATIP cars are identified by Universal Machine Language Equipment Register (UMLER)[1] (listed as private equipment) and publicly recognized with the DOTX prefix on the car body above the truck. They are officially DOTX series 216, 217, 218, 219, 220, 221, and 223. All ATIP cars are operated in tow mode although DOTX 217, 218, and 219 can be self-propelled. Self-propelled is a limited mode of operation. .

FRA policy defines the self-propelled ATIP cars as specialized maintenance equipment (SME) and they may not reliably shunt track signal circuits. As a result, certain operating restrictions apply. By policy, ATIP cars are not considered locomotives[2] (even though they have cab controls and couplers). Operating as an SME relieves ATIP contractors from maintaining locomotive engineer certification and hours of service regulations and other requirements. As an SME, self-propelled ATIP cars are not subject to Title 49 Code of Federal Regulations (CFR) Part 229, but are amenable and will act in accordance with the safety appliance section and other pertinent sections of the regulations.

ATIP cars operate safely in accordance with all railroad operating rules. ATIP self-propelled geometry car movement has one rule exclusion; following absolute block protection must be maintained and supersedes railroad operating rules or equivalent protection given to a train[3] or on-track equipment. ATIP cars in tow mode will follow the railroads operating rules for dispatching and protection.

ATIP cars offer advances such as crashworthiness protection, high-speed trucks, satellite communication, and asset management—including innovations in ride-quality accelerometer measurement and the differential global positioning system (GPS) for precise location of track exceptions. FRA has developed a secure Web site (https://www.fra.dot.gov/Page/P0120) to

[1] UMLER is a registered rail equipment reference, e.g., DOTX 217 is the same as T17, etc.
[2] 49 CFR Part 229, Subpart A – General, § 229.50(k), Definitions
[3] 49 CFR Part 236, Subpart G – Definitions § 236.832, Train

facilitate and improve communications. The site contains survey schedules and operational information.

## *Modes of Operation*

1. **Manned Operation** (Normal Mode)- This is the mode where the FRA Track Inspector is on board the car.
2. **iTrack**- This mode the Track Inspector is on the car for a partial trip or not at all. An exception summary is emailed directly to the Track Inspector for every 5 miles the Geometry Car travels. See Appendix B for further details about iTrack.
3. **Amtrak Assessment**- This mode is when one of the Geometry cars is coupled into an Amtrak consist. This will produce two types of reports: Non-Compliant Exception Report(NCER) and a Track Assessment Report(TAR).
4. **Remote Track Geometry Measurement System(RTGMS)**- This is when there are no personal on the Geometry car and the data is being edited near real time in a remote location. This mode will also create a NCER and TAR.

## *On-Track and Onboard Safety*

ATIP cars are required to operate safely in accordance with railroad rules, Federal regulations, and FRA policy. Safe ATIP inspection surveys are the responsibility of everyone on board. Assigned FRA personnel are responsible for the authority, enforcement, and control of this policy. Inspectors must report any unsafe situation to FRA regional or headquarters managers.

ATIP contractor employees must conduct activities in accordance with the specific instructions conveyed in the *Safety Manual for FRA Survey Cars.* The Federal Track Inspector, in coordination with the Survey Director, will provide a job briefing on general geometry car safety, apparatus, and on-track protective procedures whenever anyone comes on board or leaves the ATIP car and fouls a track. The on-track safety job briefing will discuss, at a minimum, the following:

1. General communication methods and procedures during emergencies.
2. Location of geometry car safety apparatus (i.e., fire extinguishers, first-aid kits, breathing apparatus, and identifying individuals on board who are trained in CPR).
3. Procedures for egress through specific doorways and windows.
4. Applicable physical and operating hazards and procedures when fouling the track.

The FRA Track Inspector is responsible for ensuring that everyone on board the ATIP car is briefed and updated, as safety conditions or events change throughout the day. Before exiting the car and fouling the track occupied by the survey car, on-track safety is established by using the ATIP car's exclusive authority to move on controlled track (train coordination). All train movements are coordinated with the Survey Director.

Whenever the ATIP car stops to evaluate a track condition, conduct instrumentation checks, or carry out repairs, FRA Track inspectors will ensure the following:

1. A railroad Employee-In-Charge (EIC) ensures appropriate on-track safety requirements and a job briefing before fouling the track.

2. FRA Track inspectors, the railroad EIC, and ATIP car personnel are reminded that train coordination, as previously discussed, in coordination with the Survey Director, may afford on-track protection. Before fouling any other track protection such as train approach warning must be used.

If a railroad employee is unavailable to assume the in-charge role, the FRA Track inspector may afford on-track safety in accordance with FRA policy as follows:

1. Two FRA or State inspectors may work together and use train coordination as protection on the track occupied by the survey car and on non-controlled track with one acting as a watchman/lookout for the other, if they know the operating characteristics of the railroad at that inspection point, including train speeds.
2. An FRA or State inspector working alone is authorized to use train coordination on the track occupied by the survey car or individual train detection on non-controlled track. The individual inspector's responsibility is to obtain the information necessary to provide proper on-track safety.

FRA may invite guests on an ATIP car. However, guests are not authorized to occupy the track without the permission and protection afforded by either FRA or the railroad. The term "guests" does not include ATIP contractor personnel who are agents of the Government.

## *Operations*

In case of manned survey operations, ATIP crewmembers usually consist of a Survey Director and three others whose responsibilities include safe operation of the car, calibration, and maintenance of the instrumentation, and collection of survey data. ATIP car survey operations generate a track geometry inspection report (TGIR), video charts and imagery in electronic format.

A survey schedule is distributed regionally. FRA Track and OP Specialists review the schedule outline and provide route feedback. Upon regional acceptance, the schedule routes are applied to a monthly calendar format and accessible on the ATIP Web site at https://www.fra.dot.gov/Page/P0120.

As a contract requirement, an Office of Railroad Safety official notification letter and an operations plan are distributed to the respective railroads and applicable regions at least 3 months in advance of the survey. The content of the letter details FRA's authority, operations geography, contact personnel, and other pertinent information. A daily ATIP schedule identifies normal railroad crew change points that estimate travel time that the ATIP car should achieve in a 12-hour day.

## *Daily Deployment*

An active survey contract workday averages 13 hours per day with 1½ hours consisting of pre- and post-survey work. Survey on-duty time should not extend beyond 12 hours. However, it is understood that certain justifiable operating delays might occur from a variety of causes; unforeseen railroad operation, ATIP car equipment failure, or an emergency occurrence. Conditions that explain the reason for excessive delays, beyond 12 hours, require documentation by the contractor, concurrence by the Track inspector, and preapproval by the regional and HQ managers, as necessary. Provable operational delays, which result in going beyond the average daily hours because of subjective decisions to reroute and give priority to

other traffic, must be well-documented by the Inspector in charge. If unreasonable delays occur due to differential priority treatment, the railroad may be subject to forfeiture of reimbursable costs and fined under the law or regulations.

Occasionally, the ATIP schedule may be altered to correspond with minor changes effecting daily start and stop times or locations. The distribution and coordination of necessary schedule modifications to the respective railroads and FRA regions, by way of earliest means, is essential. There should be no substantive changes to the final schedule 2 weeks prior to the survey, unless an unforeseen circumstance occurs. Last-minute changes have an undesirable effect, are difficult to make, and affect the overall schedule in other regions and railroads.

ATIP priorities and risk-based route scheduling preference involve primarily:

1. Inspector observations, regarding deteriorating or noncomplying track geometry, associated with structural conditions, e.g., crossties, ballast, etc.
2. A railroad's compliance history, exception repeatability, degradation rate, and track quality.
3. Duration between last inspections (i.e., between 2- and 4-year cycles where tonnage is more or less than 50 million gross tons, respectively).
4. Passenger operation (i.e., Amtrak and applicable commuter/freight territories, such as Southeastern Pennsylvania Transportation Authority, Metropolitan Rail Corporation, Long Island Rail Road, Northeastern Illinois Regional Commuter Rail, etc.
5. Designated hazardous material and Strategic Rail Corridor Network (STRACNET) routes;
6. Railroad operating speeds greater than 20 mph.
7. Other special regional needs or activities (e.g., the 2002 Winter Olympics in Utah).

Regions located in the northern latitude are normally scheduled in late spring through early fall, and those in the southern latitudes can expect the ATIP car through the winter months.

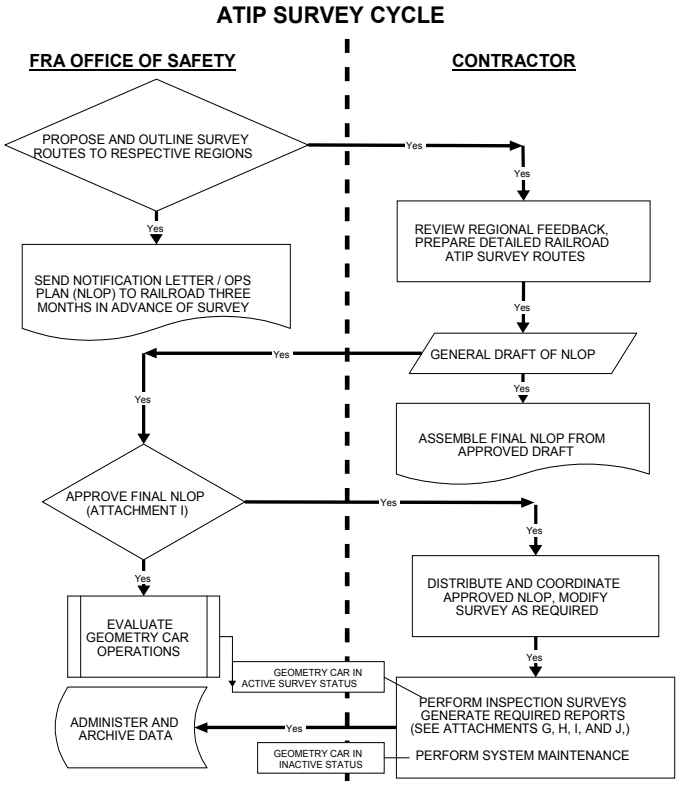



Figure 1

## *Track Geometry Measurement System (TGMS)*

On board ATIP cars, TGMS instrumentation generates automated signals processed online by a computer, which produces a graphical record of detailed track geometry measurements. The measurements recorded are gage, left and right rail alignment and profile, crosslevel, superelevation, warp, harmonic rock, run-off, and limiting speeds. ATIP cars measure and record existing track geometry conditions and compare those measurements to ensure compliance with the 49 CFR Part 213, Subpart C for the lower speeds (Classes 1–5), as well as Subpart G (Classes 6–8) for high speed to determine compliance with:

1. Track gage in inches, measured ⅝ inch below top of rail.[4]
2. Profile (humps and dips) deviation from uniformity of a 31-, 62-, and 124-foot midchord offset (Class 6 and above) in inches.
3. Alignment deviation from uniformity of a 31-, 62-, and 124-foot midchord offset (Class 6 and above) in inches.
4. Crosslevel on tangent track in inches.
5. Crosslevel deviation from uniformity on spirals and curved track in inches.
6. Curvature.

[4] Excessive vertical and horizontal rail headwear or rail section design may produce errors, unless properly adjusted.

7. Warp using a variable base length up to 62 feet on tangent, spiral, and curved track, in inches, and a 31-foot section on spiral track;
8. Length of spiral portion of curved track and rate of elevation run-off or run-on.
9. Calculated unbalanced amount in inches.
10. Limiting speed (mph) in curves (based on amount of superelevation and degree of curvature).
11. Harmonic rock, as created by six pairs of low joints, each pair exceeds 1¼ inch.
12. Run-off in 31 feet *.
13. Twist 31 *.

*Denotes exceptions are advisory. Condition can occur if criteria are met. Further investigation is needed.

**TGMS Definitions**

**Alignment**: Alignment is the projection of the track geometry of each rail or the track centerline onto the horizontal plane.

**Crosslevel**: The difference in elevation between the top surface of the two rails at any point of railroad track.

**Curvature**: The degree of curvature is defined as the central angle subtended by a chord of 100 feet. Theoretically, it should be by an arc of 100 feet. The chord is used for easy measurement in field. Since the degree of track curvature is usually small, there is little difference when using a chord or arc.

***Gage**:* The measurement 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.

**Profile**: (Vertical surface) Profile relates to the elevation along the longitudinal axis, which is an adherence to an established grade and the incidence of dips and humps.

**Run-Off**: Elevation (ramp) difference of a line along the top of the rail is used for the projection.

**Superelevation**: A constant elevation of the outside rail over the inner rail maintained on curves, as well as a uniform rate of change on spirals, and measured in the same manner as crosslevel.

**Twist:** The difference in crosslevel between two points of a fixed distance.

**Warp**: The difference in crosslevel between any two points within the specified chord length.

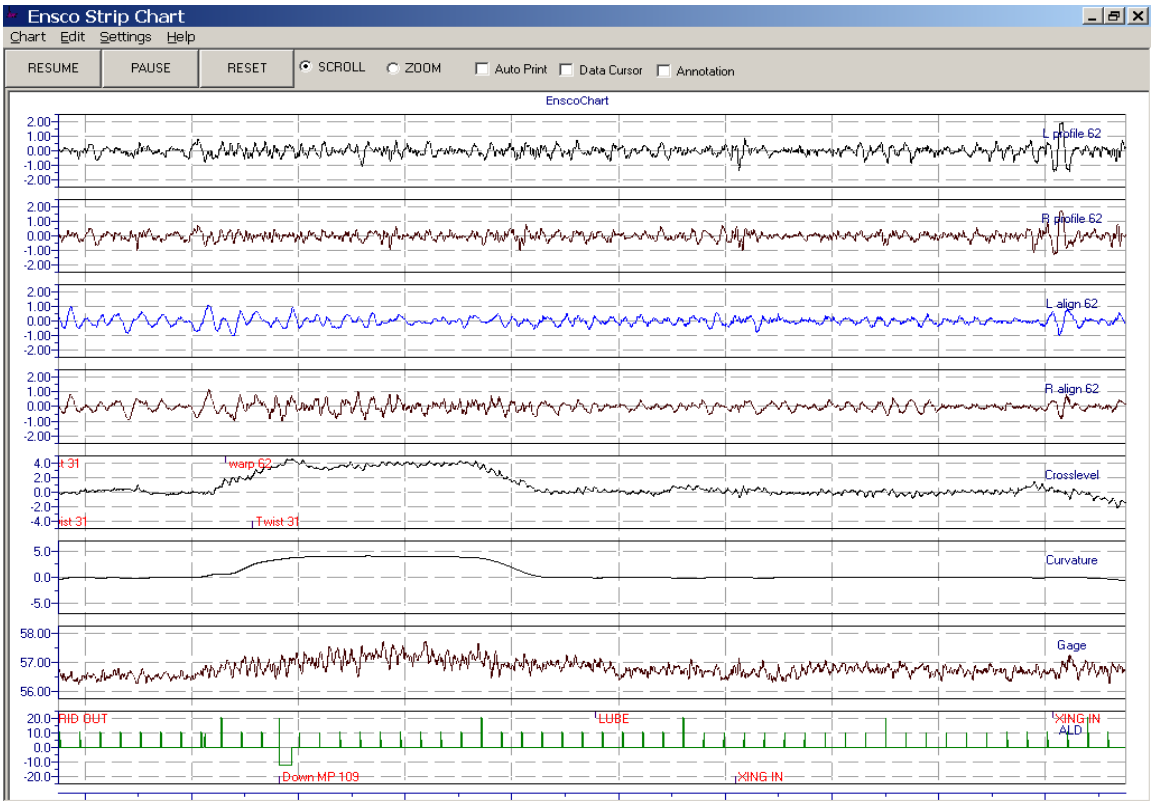
## *Exception Detection*

The exception detection process compares the geometry data to the exception thresholds. When an exception is detected, the exception detection process provides the type of exception,

the location (start of exception, end of exception, and peak location), and the value of the exception.

**Stripchart**

The multichannel video stripchart (illustrated in the following figure) continuously displays geometry values, i.e., left and right profile or run-off, left and right alignment, crosslevel or curve superelevation, degree of curvature, gage, and automated track event location detection (ALD) references.




When viewing the stripchart, the ATIP car direction is always from the left-hand margin toward the right-hand margin. Representative lines, drawn on the stripchart, reflect track quality. The dash lines represent the upper and lower class limits. The exception trace lines differentiating noncomplying conditions may indicate that operational and/or maintenance remedial action is necessary. Electronic and paper copies of the stripchart defects are provided on demand so that noncompliance with federal regulations receives immediate attention. In an effort to reduce paper consumption, inspectors can view ATIP geometry information electronically using GeoEdit software. The same information is viewable for authorized users in FRA's Track Data Management System *(https://tdms.ensco.com/tdms_lite).* The eight channels are selectable in any order in GeoEdit.

**The profile channel** combines left and right profiles and shows run-off. The centerline is equal to zero; profile measurements above the centerline indicate a dip and profile measurements below the centerline indicate a hump.

**The alignment channel** displays left and right alignment. On tangent track, the centerline is equal to zero; alignment exceptions above the centerline are considered outward from the track center, and measurements below the centerline are considered inward to the track center.

**The crosslevel channel** indicates crosslevel deviation, warp, rock off hazard, and superelevation. A line plotting above of the centerline indicates the left rail is the high rail, and plotting to below the centerline indicates the right rail is the high rail.

**The curvature channel** displays degrees of curvature. Correct selection of curvature (5, 10, or 20 degrees) is dependent upon the physical layout of the track. Curvature trace lines plotting to below the centerline are left-hand curves, and plotting above the centerline are right-hand curves, as viewed in the direction of travel (such as left to right).

**The gage channel** displays gage measurements. Nominal gage is 56½ inches. Measurements above and below the nominal gage are read directly as either wide or narrow gage, respectively.

**The ALD channel** is usually illustrated on the very bottom. Each milepost marking, track number, and current class of track tested is reported and assists in locating track exception. The curvature scaling with the file number (in the year, month, day, and file number format [yymmddxx] is posted on the right border. Location references consist of event message numbers that clearly indicate mileposts and other wayside features such as road crossings, bridges, and trackside detection devices (e.g., hot boxes and clearance devices) are detected and manually entered in the data stream by the contractor. Smaller and larger vertical lines indicate 100- and 1,000-foot track segment division, respectively.

Other features may be marked automatically on the chart when ALD equipment senses their presence magnetically (i.e., turnouts and wayside detection devices). This allows inspectors and host railroad representatives to easily locate exceptions from either the analog or video chart references at the time of occurrence.

**Video Stripchart**

A video stripchart outline begins with a header that contains the following information:

- Date
- Railroad name, division, subdivision, and line code segment
- Geometry car (i.e., DOTX 219)
- Survey number
- Track class
- Location from
- Location to
- Posted speed
- Milepost start/end

- Track
- Type (single, multiple, double main, etc.)
- Track direction (north, south, east, or west)
- Scan rate
- Video number

The information is arranged as a plot where each of the measurements, with the exception of the wayside features data, forms a continuous line moving to the left or right as the measurement changes. The stripchart is only printed on the car when an exception is found. The stripchart will have 1 mile worth of information on it with the exception being centered on the page. The entire stripchart can be requested and delivered in a PDF format for the entire run.

**Track Geometry Inspection Report (TGIR)**

The TGIR contains a list of all exceptions identified during a survey. The report header includes:

- Location and name of events, including speed and class of track changes
- Header information
- Exception
- Start location and footage
- End location and footage
- Length of exception
- Differential GPS locations
- Maximum value
- Maximum value location
- Exception limit
- Track
- Maximum train speed
- Posted class (timetable)
- Complying track class (differentiating one-class or more-than-one-class drop)
- Space for date corrected
- All other outputs from additional measuring devices (rail profile and corrugation)

Manual or automatic entry supplemental information is required to properly evaluate and locate track geometry exceptions. Therefore, provisions are incorporated to permit the Data Specialist to enter other exceptions, such as:

- Milepost number
- Track class (FRA TSS 1 through 8)
- Track type (passenger, freight, or both)
- Track number
- Track or wayside features

**Class Plus One**

Class plus one is a section of the TGIR report that will provide the FRA Inspector and the Railroad with exceptions for the next class up from the posted class by timetable.

**Number of Channels**

At least eight channels can be displayed that may be selected from all stored data from the TGMS or the Ride Quality Measurement System. All appropriate scales for each channel are marked on each chart. At a minimum, the following channels are displayed:

- Left profile
- Left alignment
- Right profile
- Right alignment
- Superelevation
- Curvature
- Gage
- Location
- Car body lateral acceleration (CBL)
- Car body vertical acceleration (CBV)
- Truck frame lateral acceleration (TL)

## *Standard Operating Procedures (SOP)*

**Test Speed Classification**

ATIP cars always comply with the operational speed requirements. However, FRA policy does not necessarily recognize all “slow orders” in terms of track classification. Railroads place general orders (GO) or track bulletins (TB) for a variety of justifiable reasons, i.e., operational, structural, and geometry, which are substituted for the maximum authorized train speed. Railroads also may elect to reduce train speed to expedite train and ATIP car movement in advance of ATIP surveys by placing a temporary slow order (TSO), so-called “blanket slow orders,” over long segments of track. Subsequently, geometry data may be reprocessed to the maximum authorized train speed. The geometry car will operate at the temporary speed but

testing will be done at the maximum posted timetable speed while a blanket slow order is in place.

For example, a timetable authorizes freight trains to operate at 40 mph, or Class 3 classification. However, a valid and verifiable TB reduces freight speed to 25 mph, a Class 2 classification, because of a crosstie condition. As a result, inspectors will allow ATIP cars to inspect and record exception to the Class 2 safety limits. In another example, on the day of the survey, a railroad issues a slow order reducing train speed from 70 mph (Class 5) to 60 mph (Class 4) for operational reasons, such as anticipating multiple slow orders. This lowered speed will be less disruptive to the dispatcher and actually increase cooperation with ATIP car movement. Inspectors will ensure that the lower classification operating speed will be followed but will allow the ATIP car to inspect to the maximum posted timetable speed.

Any ATIP exception location and value discovered may only be edited by the inspector (through the Survey Director) from the TGIR. However, track geometry exceptions are only deleted from the TGIR and not exclusively removed from TGMS storage. Thus, exceptions are always available for subsequent review, analysis, and reprocessing.

The class plus 1 feature on the car will give the railroad and instant reprocessed report of the track at one class higher than posted. This feature will replace the need to reprocess the file to the next higher class. It is also a separate section of the TGIR.

**Clearance Restrictions**

Prior to the survey, FRA inspectors will coordinate with the Survey Director regarding current track numbers, current authorized operating train speeds, and track charts (curvature) input information for the survey. For TGMS to correctly plot the degree of curvature on video or stripchart, FRA inspectors will advise the Survey Director in advance on where curvature varies or differs from those established on a track chart in groups of 5, 10, or 15 degrees.

ATIP geometry cars comply with Association of American Railroads interchange rules, however track curvature greater than 13 degrees presents certain clearance issues and may govern or restrict car operation when towed by a locomotive. Operation of cars on curves greater than 20 degrees is prohibited. Clearance diagrams and restrictions of all ATIP cars are provided on the ATIP Web site (https://www.fra.dot.gov/Page/P0120).

**Track Designation**

For the purpose of ATIP surveys, the TGIR designates Tracks 1 through 4 as standard notations for double- or multiple-controlled track configuration, unless otherwise numbered by the railroad (alphanumeric [ABCD.1234] format). For example, a track may be designated as YL10.45. A single main track is designated as Track 5. A controlled siding is designated Track 6, and Track 7 notations represent all “other than main” non-controlled tracks and includes excepted track.

**Operational Delays/Surveys Beyond 12 Hours**

FRA inspectors are to report excessive delays greater than one-half hour and cumulative delays resulting in time exceeding 12 hours on-duty. For example, on-duty time begins when the ATIP car conducts its brake test. Inspectors will ensure the Survey Director reports recurring or

prolonged operational and repair delays, and determine the reason for the delays and/or operating constraints that are placed by the railroad (e.g., dispatching and crew delays or personnel hours of service restrictions). Inspectors are to notify regional and HQ managers if any unusual occurrence significantly affects ATIP daily schedules. The use of the onboard telephones to communicate with railroad officials to expedite movement and advise regional and HQ managers is authorized.

Although normal survey hours are expected to be conducted during daylight, operations may require surveying before sunrise and after sundown. Inspectors should address any safety concerns in a safety briefing. Personnel on board ATIP cars must know their individual limit for physical fatigue beyond 12 hours of on-duty time. Any time an unsafe circumstance exists that does not conform to railroad or ATIP procedures and instructions, the situation will be immediately addressed, resolved, and reported to FRA regional or HQ managers.

Regardless time of the day, the TGMS will always record the track conditions and produce a TGIR, unless TGMS equipment malfunctions, as specified below.

**Measurement Equipment Malfunction**

In collaboration with the Survey Director, inspectors will monitor the stripchart exceptions and verify that all channels are within scale and reading properly. Inspectors will convey this information to railroad maintenance-of-way representatives, ensuring a complete understanding of the data presented. A single-point failure, or combination, that exhibits questionable value or information of any exception, is justification to stop the survey at that location until it is repaired. A survey will not continue until the conditions are resolved. If repairs cannot be made to the geometry measurement system, ATIP surveys are not to be continued. The track segment affected will be declared as an invalid survey. Track segments identified as invalid will be rescheduled for an ATIP inspection at a later date.

Certain conditions are known to produce small variations in measured track geometry during automated surveys. These differences affect geometry measurement and are mainly caused by:

1. TGMS calibration tolerance.
2. Transition in the applied track load between survey run dates caused by speed, acceleration, or weather conditions.
3. Difference of 1-foot data sample locations.
4. Changes in track position caused by:
    - Prevailing rail traffic.
    - Rail temperature variations.
    - Physical conditions: rail and wheel.
    - Certain types of guardrails.
    - Flangeway obstructions

Under the rail profile system, specific rail sections (headfree rail) and special track work may affect where the ⅝ point on the gage side of the rail is measured automatically. Extreme vertical headwear (greater than 40 percent of the rail head area) also presents problems associated with proper measurement. This rail condition may influence the accuracy of the

TGMS and is identified on the TGIR. Under International Organization for Standards (ISO) certification, the conditions are minimized and controlled. Significant lengths of this type of rail condition may warrant an adjustment to the gage sensor by the Survey Director, but these adjustments must be authorized by FRA HQ. Where a significant amount of headwear loss is prevalent, FRA inspectors are to advise and discuss the rail condition with the railroad. Headwear loss values can be viewed with the Rail Profile System and in GeoEdit.

**Valid and Invalid Surveys**

ATIP cars inspect and produce a TGIR of all applicable mainline tracks, controlled sidings, and "other than main track" when scheduled, warranted, or the opportunity is practicable. For example, occupying a main track and directed to occupy a siding to meet another train would present an inspection opportunity on the siding track. Unplanned inspection of main or yard track, including "excepted track" designations is discretionary; however, care must be taken to prevent possible ATIP car damage from a variety of sources. Producing a TGIR is mandatory for a valid survey and will not be produced for invalid surveys or certain track segments thereof.

For ISO quality reasons, ATIP cars record geometry data when moving above a certain speed, except where conditions exist to cause damage or as designated by FRA HQ. Anywhere the ATIP car operates, the TGMS instrumentation on board will record applicable track geometry measurements. An authorized or valid survey operation occurs on condition that the following prerequisites are in place:

1. The railroad is officially notified by FRA in writing.
2. A qualified railroad locomotive engineer or pilot is on board (self-propelled or towed).
3. Authorized track speed is greater than 5 mph.
4. TGMS is online, functional, and can produce a TGIR.

An unauthorized or invalid survey (segment thereof) operation is declared if the following circumstances occur:

1. TGMS failure resulting in instrument inaccuracy.
2. TGMS instrument impairment due to snow, vegetation, high ballast levels or excessive debris, mud, and grease/oil causal factors.
3. The geometry car is "deadheading" in a train, and TGMS is offline.
4. Performing PARR testing, undergoing scheduled or unscheduled maintenance.

When valid TGIRs are produced, they will be provided to the host railroad. Those locations where certain track segments were deemed to be invalid, the inspector will <u>not</u> provide geometry data to the host railroad.

**Exception Location**

There are two basic methods of locating exceptions using the TGIR:

1. Download or enter GPS data (latitude and longitude) into a handheld GPS device. Follow GPS directions to the exception. GPS exception coordinates are listed in the TGIR. (A GPS file is available upon request from the Survey Director to use on other devices)
2. Inspectors may use the stripchart and the TGIR to find the track number and footage beyond a milepost reference to locate exceptions. Use the stripchart information to also reference exceptions to other geographical features (turnouts, grade crossings, curves, etc.).

Sometimes detection problems are encountered for reasons such as erroneous manual entry from the ATIP car, missing mileposts, and "short" miles, which means a mile may not measure exactly 5,280 feet in length. The rule is the exception distance is referenced in the direction of travel regardless of increasing or decreasing mileposts. The TGMS counts the number of feet from the last entered milepost. According to the TGIR, if the mileposts are increasing (e.g., 9, 10, 11, etc.), the footage from a milepost is added and directly read, i.e., an exception located at Milepost 10+1,584 feet would be interpreted as 1,584 feet from Milepost 10 (decimally Milepost 10.30) in the direction of travel.

If the mileposts are decreasing (e.g., 11, 10, 9, etc.), the footage on the report from a milepost is subtracted from the milepost. For example, an exception located at Milepost 10+1,320 feet (specifically between Milepost 10 and Milepost 9), would be interpreted as 1,320 feet from Milepost 10 or located at Milepost 9+3,960 feet (decimally Milepost 9.75) in the opposite direction of travel. Appendix A - Conversion Feet to Decimals of a Mile is available on board and at the end of this chapter to assist inspectors. Dependent upon geometry car speed, a delay reaction time (translating to a distance of up to 400 feet) exists regarding exceptions.

Geometry exceptions, associated with a length (i.e., gage, warp, and harmonic rock), are measured from an exception reference point in the direction of travel. For example, a warp length of 56 feet is located at Milepost 9+3,960 feet, upon computer calculation; the other end to the warp is located at Milepost 9+3,904 feet (56 feet from the exception reference point, but in the opposite direction of travel). Handheld GPS receiver accuracy is usually within 30 feet of the exception location 'tagged' with the geometry car GPS coordinates.

**Exception Verification**

ATIP's TGMS (instruments, algorithms, and SOPs) are certified by ISO 17025 standards and meets the quality procedures set by those standards for all ATIP cars. As part of ISO A2LA certifications, instrument verifications (IV) are made a minimum of three times per day on days with more than 100 scheduled miles and two times on days scheduled less than 100 miles and stripcharts are continuously monitored to ensure that TGMS is within allowable tolerances. Track gage conditions deemed as unsafe (in excess of 58½ inches) must be field verified. FRA inspectors must stop the ATIP car when encountering an unsafe level condition and verify geometry car measurements. All other on-track verifications will be at the sole discretion of the inspector. ATIP also conducts specialized random quality assurance field validations.

Railroads may question the accuracy of a reported exception. In those cases, the FRA inspector may stop the car and substantiate the exception by conducting additional instrument verifications and/or direct track measurements, as long as the activity is supervised under proper on-track safety procedures. If track structure, geometry, and operating circumstances

warrant, inspectors may assess and consider a violation citation, in accordance with Volume I, Chapter 4.

ATIP satisfies 49 CFR § 213. 13 requirements to measure track under load. ATIP cars normally apply a lateral and vertical dynamic load and correspondingly, TGMS calculates the geometry compliance. Speed and impact factors determine the level of rail movement under load. Measurement under load (dynamic) must always be considered—the only exceptions are narrow gage, and guard face and check gages. Car wheels forcing a narrow gage or guard check and face gage condition outward are not measurement-appropriate under load (49 CFR § 213. 13).

It is important for the inspector to verify (reinspect) geometry measurements following an ATIP survey (see Source Code J). Inspectors should be confident geometry measurements are correct and accurate, and they should be ready to disprove any contentions that the measurements aren't accurate. Also keep in mind that static measurements will almost never exactly equal that of a dynamic (100-ton car) measurement.

**Exception Remediation**

Providing the ISO quality standards are met, inspectors will recognize exceptions discovered by ATIP cars as abiding to FRA's constructive knowledge standard in accordance with 49 CFR § 213. 5(a) Responsibility for compliance. It is the railroad's responsibility to decide the remedial action when notice is given (ATIP survey), stating that their track does not comply with the safety standard requirements. Proper exception remedial action must be taken at the time of discovery by railroad representatives. Inspectors may not impose remedial action en route, except when stopping and verifying validity or in response to railroad remedial action. Inspectors should consider citing violations when conducting an on-the-ground reinspection of an unsafe track condition (see Source Code J).

After an ATIP survey, reinspections determine if appropriate remedial actions have been taken and are at the sole discretion of the inspector. Proper source codes for this are located in this section under "Reports." Prior knowledge is met when the railroad is given a TGIR and enforcement action should be considered when remedial action has not been taken.

**Reverse Movement**

To accomplish on-the-ground track exception verifications or for other purposes, ATIP car movement in the reverse direction will be conducted in accordance with railroad operating rules. Conductors will position themselves to oversee the reverse movement and communicate with the Engineer in accordance with railroad operating rules. Reverse movements are limited by:

1. Operations through an interlocking.
2. Operations over multiple highway-rail grade crossings.
3. Operations of a significant distance (usually 2 miles or more).

**Speed Limitation on Curves**

The $V_{max}$ formula considers the average variable of actual elevation and curvature, and the amount of unbalanced elevation or cant deficiency in determining the maximum curving speed

allowed. Curving forces become more critical if variations in track, equipment characteristics, or improper train handling conditions have not been abated. For guidance on speed limitation on curves, see 213.57 in Volume II Chapter 1 of this manual.

### Geometry Car Security

Track inspectors are responsible for proper security of the ATIP car and must use good judgment and discretion in the application and placement of protective devices and train control signs (e.g., red or blue flags), as circumstances warrant. To prevent undesired access when the geometry car is unoccupied, FRA inspectors will ensure contractor personnel always provide protective measures. FRA inspectors will notify both regional and HQ staff if conditions exist that do not allow protective devices to be applied.

### Highway-Rail Grade Crossings

All ATIP geometry cars are operated in a towed manner with a lead locomotive. If a geometry car is operated self-propelled, all occupants in the controlling compartment of the geometry car are responsible for ensuring the way is clear when approaching highway-rail grade crossings equipped with either passive or automatic warning signal system devices as detailed below:

1. The rate of deceleration on self-propelled geometry cars must be controlled to speeds deemed appropriate, based on the local conditions (e.g., gradient, visibility, individual rail surface stopping conditions) and approach a highway-rail grade crossing at reduced speed, be prepared to stop, if necessary, until it is known that automatic warning devices actuate.
2. If signal system failures disrupt the proper function of the warning devices, the occupants must be able to respond immediately.
3. The railroad representative reports warning system malfunctions to the dispatcher according to 49 CFR Part 234.
4. Take precautions not to interfere with the normal function of the automatic warning signal system devices. The exception to this is on condition that proper flag protection against highway vehicles is provided by railroad or contractor personnel when automatic warning devices fail to fully activate or when the host railroad's rules require an exception, Part VI of the FRA Manual on Uniform Traffic Control Devices provisions, or FRA regulations.

## *Reports*

### Document and Data Control

To ensure ATIP reports are delivered to those persons FRA authorizes, the Survey Director only delivers the TGIR reports to FRA Track inspectors. In absence of the FRA Inspector being on board the Survey Director has the authority to hand out TGIR's to the railroad on board. It is the responsibility of the FRA Track Inspector to authorize distribution of a sufficient quantity of reports (paper or electronic) to the railroad representative on board. Additionally, the Survey Director enters into the survey log the name, contact information, and the number of reports the railroad representative receives. The survey log is retained and kept on file with the daily survey documentation. If a FRA inspector is not on board, the Survey Director will provide a report to the accompanying railroad representative.

## FRA Track Inspection Report

Inspectors are to prepare an FRA Track Inspection Report (Form F6180.96) for each ATIP survey, with appropriate source codes and the survey number. See Volume I, Chapter 2 of this manual for instructions on preparing Form F6180.96. Inspection surveys may involve multiple reports on a given day. Inspectors may complete multiple .96 report forms and assign among themselves different railroads surveyed during the day and reinspection activities. To avoid duplication and distorting the FRA database, only one .96 report form will be completed for each survey segment or railroad, even though more than one Inspector may be on board.

## Source Code

### I ATIP ACTIVE AND INACTIVE SURVEYS

Use Source Code I, with the reporting marks of the railroad, followed by an Office of Railroad Safety-assigned ATIP survey file number, e.g., XXXX_0123. Source code I will be used when inspecting track in conjunction with ATIP active surveys. The report header on the .96 report form is to be filled out during this inspection activity, and exceptions listed by the geometry car are to be appended and recorded on the .96 report form line items. Enter all units of inspection in the activity code box. Ensure that the survey miles accurately correspond (verified by the Survey Director) with the daily number of miles operated by the geometry car. When conducting an inactive survey, use Source Code I, but list only the mileage operated by the geometry car.

### J ATIP FOLLOWUP REINSPECTION

Use the ATIP number corresponding to the original survey files number (e.g., alpha-numeric XXXX_0123) assigned by the Office of Railroad Safety. Follow-up inspections should be conducted within 30 days. Also, if the ATIP car is stopped for verification during an active survey and noncompliance conditions are cited, the Inspector must initiate a Source Code J report separate from the Source Code I report mentioned above.

When conducting ATIP follow-up inspections (Source Code J), if track exceptions—other than those reported by the geometry car—are discovered, another .96 report form with the appropriate source code must be completed. Do not combine ATIP exceptions with other exceptions on one 96 report form.

### N ATIP INSPECTION OF THE STRATEGIC RAIL CORRIDOR NETWORK (STRACNET)

STRACNET is a network of military routes important to national defense. Paper and electronic State maps are available to help identify these important routes.

## *Appendix A: Conversion Feet to Decimals of a Mile*

| Milepost Increasing up in feet | Decimal Mile | Fractional Mile | Poles | Fractional Mile | Down Feet | Milepost Decreasing Decimal Mile |
|---|---|---|---|---|---|---|
| 0 | 0.000 | 0 | 0 | 1 | 0 | 0.000 |
| 132 | 0.025 | | 1 | | -132 | 0.975 |
| 264 | 0.050 | | 2 | | -264 | 0.950 |
| 396 | 0.075 | | 3 | | -396 | 0.925 |
| 528 | 0.100 | | 4 | | -528 | 0.900 |
| 660 | 0.125 | ⅛ | 5 | ⅞ | -660 | 0.875 |
| 792 | 0.150 | | 6 | | -792 | 0.850 |
| 924 | 0.175 | | 7 | | -924 | 0.825 |
| 1056 | 0.200 | | 8 | | -1056 | 0.800 |
| 1188 | 0.225 | | 9 | | -1188 | 0.775 |
| 1320 | 0.250 | ¼ | 10 | ¾ | -1320 | 0.750 |
| 1452 | 0.275 | | 11 | | -1452 | 0.725 |
| 1584 | 0.300 | | 12 | | -1584 | 0.700 |
| 1716 | 0.325 | | 13 | | -1716 | 0.675 |
| 1848 | 0.350 | | 14 | | -1848 | 0.650 |
| 1980 | 0.375 | ⅜ | 15 | ⅝ | -1980 | 0.625 |
| 2112 | 0.400 | | 16 | | -2112 | 0.600 |
| 2244 | 0.425 | | 17 | | -2244 | 0.575 |
| 2376 | 0.450 | | 18 | | -2376 | 0.550 |
| 2508 | 0.475 | | 19 | | -2508 | 0.525 |
| 2640 | 0.500 | ½ | 20 | ½ | -2640 | 0.500 |
| 2772 | 0.525 | | 21 | | -2772 | 0.475 |
| 2904 | 0.550 | | 22 | | -2904 | 0.450 |
| 3036 | 0.575 | | 23 | | -3036 | 0.425 |
| 3168 | 0.600 | | 24 | | -3168 | 0.400 |
| 3300 | 0.625 | ⅝ | 25 | ⅜ | -3300 | 0.375 |
| 3432 | 0.650 | | 26 | | -3432 | 0.350 |
| 3564 | 0.675 | | 27 | | -3564 | 0.325 |
| 3696 | 0.700 | | 28 | | -3696 | 0.300 |
| 3828 | 0.725 | | 29 | | -3828 | 0.275 |
| 3960 | 0.750 | ¾ | 30 | ¼ | -3960 | 0.250 |
| 4092 | 0.775 | | 31 | | -4092 | 0.225 |

| Milepost Increasing up in feet | Decimal Mile | Fractional Mile | Poles | Fractional Mile | Down Feet | Milepost Decreasing Decimal Mile |
|---|---|---|---|---|---|---|
| 4224 | 0.800 | | 32 | | -4224 | 0.200 |
| 4356 | 0.825 | | 33 | | -4356 | 0.175 |
| 4488 | 0.850 | | 34 | | -4488 | 0.150 |
| 4620 | 0.875 | ⅞ | 35 | ⅛ | -4620 | 0.125 |
| 4752 | 0.900 | | 36 | | -4752 | 0.100 |
| 4884 | 0.925 | | 37 | | -4884 | 0.075 |
| 5016 | 0.950 | | 38 | | -5016 | 0.050 |
| 5148 | 0.975 | | 39 | | -5148 | 0.025 |
| 5280 | 1.000 | 1 | 40 | 0 | -5280 | 0.000 |

| **Legend for Railroad Delays** | |
|---|---|
| PS | Passenger Stop (Boarding or Detraining Personnel |
| RB | Red Block (Priority Dispatching other Trains in CTC Territory: Signal Malfunction) |
| MD | Mandatory Directives Dispatching Territory (TWC, DTC, Form D, Traffic, etc.) |
| P1...Px | (Unqualified, Unassigned Crew Call or Late Reporting, etc.) |
| TS<br>Ev | Track Structure (Unsafe Geometry, Special Trackwork; Clearance;<br>Excessive Vegetation, Ballast, etc., or Obstruction) |
| GX | Grade Crossing, Signal, or other Shunting Failures |
| **Legend for ENSCO Delays** | |
| G1 | Primary Gage System |
| G2 | Secondary Gage System |
| C1 | LVDT |
| C2 | RVDT |
| C3 | CAS Package |
| P1 | Profile Accelerometer Left |
| P2 | Profile Accelerometer Right |
| RQ1 | Ride Quality Car Body Vertical |
| RQ2 | Ride Quality Car Body Lateral |
| RQ3 | Ride Quality Truck Lateral |
| PT | Paint |
| CN | Computer or Printer Network |
| P (E,F,R) | Onboard Personnel Induce (ENSCO, FRA, or Non-Operating Railroad) |
| T | Tachometer Failure |
| E1 | Engine One Generated Failure |
| E2 | Engine Two Generated Failure |
| **Environmental Delay Legend** | |
| W | Weather-Related: (Any Material {Water Over Top of Rail, Blowing Snow, Leaves, Etc.} |

## *Appendix B: iTrack Procedures for the Region*

### iTrack Operating Procedures

iTrack is the utilization of new technologies developed by the ATIP team to better allow the regions to manage their man power in regards to geometry car operations. The region may opt for either managing their territories in the traditional manner of performing inspections from the Geometry Cars or deploying a number of methods to follow the progress of the car through their territory while not being onboard. This technology allows for the inspector to receive exceptions in a real time manner by providing them with the exception, location, GPS, and a link to Google maps to show surrounding terrain.

To initiate iTrack, the Region would notify ATIP of its decision to utilize the iTrack operation and not have an inspector accompany the ATIP survey. Notification should be 90 days before the scheduled survey, or as soon as possible.

ATIP Program will modify the standard notification letter to senior railroad engineering officials that:

- FRA inspectors may or may not be present on the ATIP during the identified survey,
- FRA will notify the local railroad personnel when FRA inspectors will not be present,
- Railroad personnel are encouraged to accompany the ATIP during the survey even without FRA presence on board
- ATIP cars during the survey will not stop to verify any geometry locations when there is no FRA inspector present

Regional involvement is still required & crucial as in a normal survey, including

- Designating a regional point of contact for each day of operation
- POC will notify the local railroad personnel the day of the survey that:
    - a FRA inspector will not be accompanying the car that day,
    - ensure the railroad knows about the procedures,
    - and to let them know that the Survey Director will be in charge of the car's movement.
- Responsible for ensuring the railroad locomotive and crew are in place for each day's survey
- Ensure that the tie up point at the end of the survey day is identified and appropriate.

Survey will be conducted and data distributed as follows:

- Identify and enter email addresses recipients entered into the email list onboard the Geometry Car
- All geometry exceptions will be immediately noted and sent by email list. No Advisory exceptions will be sent by this method.
- Survey will not be stopped to verify any geometry locations

- A TGIR will be prepared, printed, and presented to the railroad person accompanying the car at the conclusion of the survey by the Survey Director.
- A TGIR will be prepared and electronically sent following the current ATIP procedures.