Designation: E 1927 – 98

AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Guide for Conducting Subjective Pavement Ride Quality Ratings[1]

This standard is issued under the fixed designation E 1927; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers a procedure for obtaining subjective numerical ride ratings for a group of representative highway pavement sections having a broad spectrum of physical characteristics.

1.2 The intent of this guide is to describe a procedure for generating a set of comparative scaled ride ratings, subjectively derived, for a subgroup of pavement sections having a ride quality distribution approximating the general population of highways of interest. This set will provide statistical estimates of the average subjective ride ratings which would be obtained for the same group of pavement sections if the entire population of users could be interrogated.

1.3 For the data to be a reasonable representation of the average ride quality judgments of the total highway user community for the total population of highway pavements, certain sampling theory precepts must be observed; The size of the rating panel, the selection of its members from the user community, the method of quantifying the individual judgments as well as the selection of the sample pavement sections are all important areas to be considered.

1.4 An important use of the resulting ride quality data would be to determine the ability of various hypothesized deterministic functions of physical parameters of the pavement samples such as measured longitudinal profile, etc., to provide an estimate of subjective ride quality judgments.

1.5 This guide is based on guidelines described in Appendix F of NCHRP Report 275,[2] and in Appendix E of NCHRP Report 308.[3]

1.6 The values stated in both inch–pound and SI units are to be regarded separately as the standard. The units given in parentheses are for information only.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods[4]

E 178 Practice for Dealing with Outlying Observations[4]

E 867 Terminology Related to Traveled Surface Characteristics[5]

E 950 Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *mean panel rating (MPR), n*—the average value, for each section of highway pavement, of ride quality ratings assigned by a ride quality rating panel

3.1.2 *ride quality rating, n*—a numerical value subjectively assigned to a section of highway pavement by an individual quantifying his judgment of the level of ride quality for that section based on a psychophysical scale.

3.1.3 *ride quality rating panel, n*—a group of highway users, statistically representative of the total expected highway user population, in rating the ride qualities of pavements.

3.1.4 *rideability, n*—a subjective judgment of the comparative discomfort induced by traveling over a specific section of highway pavement in a vehicle.

4. Summary of Guide

4.1 This guide is intended to provide a statistically valid and practical method of obtaining a set of scaled ride quality ratings, based on subjective judgments by a sample group of raters selected from the total population of expected users, for a subset of test sections selected to represent the general inventory of pavements in an area of interest. Individual ratings are obtained in a prescribed manner and averaged to give a mean panel rating (MRP) for each test section.

5. Significance and Use

5.1 A primary responsibility of highway agencies is the construction and maintenance of highway pavements in a condition (including ride quality) perceived to be satisfactory by the user community. The ability to quickly, easily and

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[1] This guide is under the jurisdiction of ASTM Committee E-17 on Vehicle-Pavement Systems and is the direct responsibility of Subcommittee E17.33 on Methodology for Analyzing Pavement Roughness.

Current edition approved Jan. 10, 1998. Published March 1999.

[2] Janoff, M.S., Nick, J.B., Davit, B.S., and Hayhoe, G.F., "Pavement Roughness and Rideability," *NCHRP Report 275,* September 1985.

[3] Janoff, M.S., "Pavement Roughness and Rideability Field Evaluation," *NCHRP Report 308,* July 1988.

[4] *Annual Book of ASTM Standards,* Vol 14.02.

[5] *Annual Book of ASTM Standards,* Vol 04.03.

economically acquire an objective standard numeric (rideability index) that will estimate the current level of satisfaction for lengths of pavement is desirable for determining when an acceptable level of ride quality does not exist and corrective measures are required.

5.1.1 This guide describes a procedure to produce subjectively derived, numerical ride quality ratings for each sample of a broad spectrum of highway pavement sections based on a standard numerical scale (0 to 5, described herein). These rating estimates may be considered to be closely correlated to the collective qualitative judgments of the total related highway user population.

5.1.2 The MPR data set thus obtained can be useful in testing various hypothesized deterministic functions of certain physical parameters of sections of pavement, such as the measured longitudinal profile, as estimators of the ride quality rating the user population might assign to any particular member of the total relevant inventory of highway pavement sections.

5.1.3 Objective, quantitative, easily measurable rideability index data shown to be highly correlated with MPRs are a valuable resource for monitoring the performance of highway pavement construction, maintenance, and repair operations.

6. Apparatus

6.1 *A Ride Quality Rating Panel*, made up of a subset of individual members of a highway user population.

6.2 *A Selected Array of Pavement Sections*, (test sections) to be rated.

6.3 *A Fleet of Vehicles*, with qualified drivers to transport panel members over the test sections.

6.4 *A Central Meeting Facility*, for administrative operations such as instruction to drivers and panel members, compilation of ratings, etc..

6.5 *Miscellaneous Materials*, such as route maps and information sheets, driver instruction forms, rater instruction forms, rating forms, summary forms, etc.

7. Procedure

7.1 The procedure presented here was developed as part of NCHRP Project 1–23 FY ’82 and is described in detail in Report 275, Appendix A, pp. 37–40, and Appendix F)[2] and further developed in NCHRP Project 1–23 (2), discussed in NCHRP Report 308, (Ref. 2, Chapter One, pp. 3–6, Appendixes A and B, pp. 24–28).[3] Excerpts from these references are included in Appendix X1 and Appendix X2 for convenience.

7.2 *Preliminary Requirements*:

7.2.1 *Pavement Test Sections*—Select an appropriate number of pavement sections in the region of interest. Each section should have homogeneous physical characteristics throughout its length. The set of test sections should be well distributed by roughness level and surface type, should be straight and free of anomalies. Sections should be of equal length, long enough to provide panel members adequate exposure and should be located so that a driving route can be developed that will allow approximately equal travel time between sections that is long enough for raters to record their values. After the test sections have been selected, the beginning and end of each section must be marked as well as the “runup” to the section.

7.2.2 *Transport Vehicles and Drivers*—Provide a sufficient number of vehicles to permit the rating panel members to be transported over the test route in one or two days. They should be of the same type and condition. Drivers should remain constant throughout the test.

7.2.3 *Ride Quality Rating Panel*—Choose a panel size based on the acceptable error (see Table 1). The panel should be composed of licensed drivers selected from a wide range of qualifications, that is, sex, age, experience, etc. In order to keep the panel study error at an acceptable level, the investigators in the NCHRP 1–23[2] study chose a panel size of thirty six members.

7.2.4 *Test Route*—Develop a test route that will traverse all of the test sections at approximately equal intervals, and includes adequate rest stops, meal stops, etc..

7.2.5 *Test Schedule*—Prepare a schedule of dates and times tests will be conducted.

7.2.6 *Materials*—Prepare an adequate supply of driver instruction forms and route maps, panel member instruction forms, panel member rating forms.

7.3 *Conduct of Rating Operation*:

7.3.1 *Driver Meeting*—At the meeting facility, as scheduled, instruct drivers concerning the experiment, that is, constant speed (usually 80 kph (50 mph)), handling of completed rating forms, etc.. Assign panel members to seating positions at this time; these should remain constant throughout the test.

7.3.2 *Panel Member Meeting*—Prior to the test run, instruct the raters regarding the rating scales, completing the rating forms, and handling the completed form. The Weaver/AASHO 0 to 5 rating scale and rating form to be used in this practice is shown in Appendix X1 (Fig. X1.1). Secrecy is required between panel members.

7.3.3 *Perform Test Run*—Transport all panel members over the entire test section route (two days might be required), with the drivers collecting the completed rating forms after traversing each test section.

7.4 *Process Data*:

7.4.1 *Mean Panel Rating (MPR)*—The mean of the panel ratings and standard deviation of the data about the mean rating may now be calculated for each test section. Where the ride quality rating panel members were in close agreement on the pavement rideability, the standard deviation about the mean panel rating will be small and should approximate the error in MPR units shown in Table 1. A test site where the computed standard deviation exceeds the error listed in Table 1 shall be removed from the ride quality study.

TABLE 1 Panel Size as a Function of Error

Error (MPR Units)	Non-Normal distribution	Normal distribution
0.1	319	138
0.2	80	35
0.3	36	15
0.4	20	9
0.5	13	6
0.6	9	4
0.7	7	3
0.8	5	—
0.9	4	—
1.0	3	—

7.4.2 *Need for repair*—The percent of rating panel members who judged that a section is in need of repair can also be calculated for each test section. The table of these values represent the product of this experiment.

8. Report

8.1 The report for studies conducted using this guide shall contain the following information:

8.1.1 *Ride Quality Ratings*—Each ride quality rating for all panel members shall be tabulated and recorded for each section included in the study.

8.1.2 *Mean Panel Ratings*—For each test section, the mean panel rating and corresponding standard deviation shall be computed and recorded to two decimal places.

8.1.3 *Study Identification Information*—General information to identify the conditions under which the study was conducted shall be recorded. As a minimum the date(s) and the type(s) of vehicles used for the study shall be recorded.

9. Statement on Precision

9.1 The standard deviation of the subjective ride quality ratings about the mean panel rating for each test site should not exceed the error listed in Table 1 (0.3 MPR units for a thirty-six member panel

10. Physical Parameters

10.1 The measurement of physical parameters of the pavement sections to be used for correlation with the mean panel ratings shall be made in the same time frame as the collection of panel rating data.

11. Keywords

11.1 need for repair; pavement ride quality; ride number; ride quality rating panel; rideability; subjective ride quality

APPENDIXES

(Nonmandatory Information)

X1. GUIDELINES FOR PAVEMENT RIDEABILITY STUDIES

X1.1 The guidelines presented here are excerpted and paraphrased from NCHRP 1–23 (Appendix E).[2]

X1.2 This appendix provides a sample set of detailed guidelines for highway agency personnel to conduct panel rating studies of rideability or ride quality. The guide describes the six key issues that must be addressed: selection of test sections and route formation, panel selection, rating procedures, panel study, date reduction, and physical measurements.

X1.3 *Selection of Test Sections and Route Formation*—This section of the user's guide describes the steps required to: identify potential test sections; select test sections; develop the route; create an inventory of the test sections and their characteristics; mark the test sections; and inform maintenance departments about the necessary deferment of repair work on the test sections:

X1.3.1 *Identification of Potential Test Sections*—Identification of potential test sections is begun by reviewing historical roughness data, including road logs or inventories, pavement roughness or serviceability index data, and local knowledge. Some states have road logs or pavement inventories (by particular district, division, or county) which describe the physical and geographical characteristics of pavement sections. For example, the road log books of the Pennsylvania Department of Transportation (PADOT) include the following informative data: legislative route, station number, maintenance functional code (MFC), functional class code, federal-aid status, traffic route, urban or rural location, length of test section, average daily traffic, surface width, year built, year resurfaced, and description of pavement.

X1.3.1.1 Some of these data can be useful background for identifying pavement and other characteristics of routes. The road log can provide the historical record of when routes were constructed and repaired and also can provide a logical starting place for the field survey team. For example, determining where to look for extremely "rough" road surface sections could be logically deduced from routes that were constructed long ago or have a history of frequent repair (such as a route that is in a poor drainage area where the road surface often cracks). Determining where to look for an extremely "smooth" road could be logically deduced from identifying the newly constructed highways or the roads that have been freshly overlaid with new asphalt. In addition, traffic patterns identified in the road logs can give the survey team an idea of what level of pavement roughness can be expected on certain routes.

X1.3.1.2 A second source of information is the available pavement roughness data from the Highway Pavement Management System (HPMS) data collected by state transportation agencies for the Federal Highway Administration HPMS program.

X1.3.1.3 A third source of information that provides leads for determining where potential test sections might be located is to interview local maintenance engineers or other highway maintenance personnel who are familiar with the highways of the area. It is very likely that such persons can inform the field crew of "rough" or "very smooth" pavement sections with which they are familiar.

X1.3.1.4 From the leads provided by historical roughness data, the next step would be to visit the sections, determine the feasibility of using the section, and make notes on additional test sections that may be useful to include in the study.

X1.3.1.5 Once potential sections have been identified, roughness measurements should be made to give the research team an accurate assessment of the roughness of these sections.

X1.3.1.6 Historic information only provides the leads in finding potential sections that might meet the roughness ranges required for the study; a field survey team still has to go out and find the sections and ensure that they meet the requirements described in the next section.

X1.3.2 *Selection of Test Sections*—There are four general criteria that must be met to include a potential test section into the panel rating study. Each section should: be one and only one of three pavement surface types; bituminous concrete, portland cement concrete, and composite; have appropriate roughness (that is, all levels required); have uniformity of roughness throughout test section; and have appropriate length.

X1.3.2.1 Twenty test sections for each of the three pavement surface types are preferred for the study. It is advisable to have a few extra sections of each pavement surface type in case some of the original sections have to be dropped at the time of the panel study. There are various reasons why this may be necessary, including unacceptable differences in the individual panel ratings, knowledge about slow-moving farm vehicles that could impede the rating vehicle, maintenance work scheduled for the site, and seasonal conditions (such as flooding or mud and dirt on the road in the springtime). The 20 sections should, taken together, span the widest possible range of roughness.

X1.3.2.2 During field visits the crew should make an estimated guess of the roughness level of the section, using the Weaver/ASHTO subjective scale of 0 to 5 discussed and justified in NCHRP Project 1–23.[2] The estimates will provide an idea of the number of sections that fall into each level of roughness. Table X1.1 provides an alternate guide to estimating subjective roughness levels based on International Roughness Index measurements.

X1.3.2.3 Uniformity of roughness throughout the test section is extremely important for the study. One anomaly (such as a pothole) in a relatively smooth section of pavement surface can affect a panel rating. One of the most common anomalies that prevents using a potential test section is the case where the end is at a bridge expansion joint. The “clunk” heard as one drives over the expansion joint is an anomaly that must be avoided in test section selection. However, a section that has numerous “clunk” sounds, such as a road with many potholes, is a good prospective site for a very rough test section (that is, 0 to 1 subjective rating). Other anomalies include: bridges, railroad tracks, asphalt patches, or isolated potholes.

X1.3.2.4 The test section area should include a preliminary warning section, the actual test section, and a follow-up section. The entire section must have uniform roughness characteristics. The test sections should be driven at posted speeds. Based on driving speed, the length of the actual test section should be long enough to provide a 25 s exposure time. A section whose operating speed is 80 kph (50 mph) should be approximately 555 m (1820 ft) long; 65 kph (40 mph), approximately 450 m (1480 ft) long and 50 kpm (30 mph), approximately 350 m (1150 ft) long. In addition, the preliminary warning and follow-up sections should be approximately 100 m (328 ft) long.

TABLE X1.1 Approximation of MPR from IRI Measurements

IRI Measurement m/km (in/mile)	Approximate Mean Panel Rating (MPR)
0.4 (25)	4.5
0.8 (50)	4.0
1.2 (75)	3.5
2.0 (125)	3.0
3.2 (200)	2.5
4.7 (300)	2.0
7.9 (500)	1.5
12.6 (800)	1.0

X1.3.2.5 While visiting potential sections and looking for additional test sections, one should keep a field notebook to inventory the sections. Information in the notebook should include: a section identification number; location by traffic route, mileage test station, and other geographical information (that is, county), speed limit, direction of travel, pavement surface type, and field survey team “guestimate” of pavement roughness level and historic HPMS roughness measurements.

X1.3.2.6 In addition, test sections should not be selected if they are on sharp curves or steep inclines. For sharp curves it is difficult for the driver to maintain constant speed throughout the test section; on steep inclines, the potential conflict with a truck or other slow-moving vehicle ascending the incline in front of the test vehicle may affect the driver’s ability to maintain the test speed during the panel rating sessions.

X1.3.3 *Route Information*—Once a large sample of test sections is selected that encompasses a wide range of roughness levels for each of the three surface types, the test section should be located and marked on a map of the area and identified by surface type and roughness.

X1.3.3.1 The test sections should then be linked together into a route that minimizes travel time across the route, equalizes travel time between test sections, and allows time between test sections for panel members to rate the site and prepare for the next test section.

X1.3.3.2 Large gaps of mileage between sites should be filled with dummy sites. These dummy sites are treated in the experiment as real test sections, but are not used in the analysis of the data. A 2- to 10-min gap is considered a reasonable amount of time between test sections. If the gap is more than 10-min, it is recommended that a dummy site be included between the sites.

X1.3.3.3 The route can either be a one-day trip of one loop or a two-day route of two distinct loops. The latter is more common and easier to conduct. The beginning and ending points of the route should be near the facility that is used for the central meeting location. In addition, restaurants, rest stops, and comfort stations should be located approximately every hour into the route.

X1.3.4 *Test Section Listing and Maps*—Once the route is formed and test sections are selected, a final listing of all the test sections should be developed. Information in the listing should include, at the least, the following: test section number, a roughness index value, traffic route name, test section location, lane of travel, and test speed.

X1.3.4.1 A map of route and written driving instructions should be developed. The map should include major highways, towns, and location of test sections. The written driving instructions should include the location of each test section on the route, the driving order of the test sections, all turns on the

route, rest stop and restaurant locations, and landmarks.

X1.3.5 *Marking Test Sections*—During the initial site visits and field work stages potential test sections (including the warning and follow-up sections) should be temporarily marked with either "flag" tape, that usually comes in bright red or yellow-green colors, or small paint markings. The tape should be put on vertical objects (such as guardrail/guiderail, telephone poles, sign poles, or utility poles) and can be nailed or tied to the surfaces. Paint or surface marks can be placed either on the road surface, on the shoulder, or on a vertical object.

X1.3.5.1 Once the test sections are finalized, a more permanent marking (such as spray paint) can be applied to the test sections. Paint markings (rectangular patch) should be applied on the road surface at the upstream warning point, at the beginning of the actual test section, and at the end of the actual test section. Each can be a different color for positive identification. In addition, a marking should be applied on a vertical object (such as a telephone pole) near the upstream warning point. This vertical marking makes it very easy for the driver to spot the section while driving the route.

X1.3.6 *Deferred Maintenance*—Once final markings are in place it is wise to notify maintenance crews of the road markings and make an attempt to prevent them from repairing any of the test sections. The "rougher" test sections are usually in more jeopardy of being repaired first, so it is extremely important to bring these sites to the attention of the maintenance department as soon as possible.

X1.4 *Panel Selection*—This section of the user's guide discusses the sample size, characteristics, and recruitment procedures for panels:

X1.4.1 *Size and Characteristics of Test Panel*—The size of the panel should be at least 36 persons and should include drivers of all ages and years of driving experience and not be over-represented by young drivers. Panelists should be residents of the state for at least five years. More than 36 persons should be identified to allow for sickness and unavoidable absences of subjects during the panel study.

X1.4.1.1 Results of previous studies have shown that the sex of a panel member is not a critical factor in the subjective rating of highway roughness, but it is advisable to include members of both sexes in the panel. Similarly, for the type of subject (that is, laymen rate the roads the same as engineers involved with road construction, maintenance, or evaluation) it is advisable to include panelists from all walks of life.

X1.4.2 *Recruiting Members*—The most effective method for recruiting panel members is to select a sample of people from the state agencies that are affiliated with the groups conducting the panel study.

X1.4.2.1 Other recruiting methods include borrowing other state personnel and placing advertisements in local newspapers and magazines. Elderly panel members, who are sometimes difficult to find for some research experiments, can be recruited from automobile and senior citizens clubs.

X1.4.2.2 Each prospective member should complete a ′Panel Selection Form' that describes the person's age, driving experience and availability for the panel study. Each panel member will be scheduled for testing on two consecutive working days (for a two-day route). The days must be consecutive (for example, Monday/Tuesday or Wednesday/Thursday. Friday is set aside for a tentative makeup day if rain or another emergency postpones an earlier day in the week).

X1.4.2.3 For each two-day period, groups of three panelists should be formed. The number of groups during any two-day period is determined from the availability of drivers and vehicles. Four drivers/vehicles are preferred, requiring 6 days for 36 panel members to be tested.

X1.4.2.4 Once panel members have been scheduled they are given an identification number and notified of the testing dates and meeting location. A follow-up call the day before the test date is advised to remind panel members of their participation dates.

X1.4.2.5 Panel members from state agencies are frequently given a meal allowance for lunch each day of the study. Likewise, panel members from outside the state agencies should be given a meal allowance for their participation in the study.

X1.5 *Procedures for Conducting the Panel Rating Study*—Appendix X2 details the steps and procedures for conducting the panel study:

X1.5.1 *Preliminary Steps*—Before conducting the actual panel study the following steps should be taken:

X1.5.1.1 Drivers should be selected and become familiar with the route and the location of the specific test sections. Familiarity with the route can be achieved by driving the route a few times. (It is desirable to use the same people who marked test sections as drivers since they would already be familiar with the route.)

X1.5.1.2 Drivers should be trained on how to deal with inclement weather. The panel rating can be conducted in light rain. However, during a sudden downpour or an intense period of rain, it is advised to discontinue the route and either stop at a rest facility until the rain subsides or continue the route on the next day. Puddling that causes noise as the car traverses a test section must be avoided.

X1.5.1.3 The drivers should also be made aware of how to deal with slow moving vehicles, such as a truck upstream that may conflict with the driver's ability to maintain speed in the test section. In this scenario, it is advisable for the driver to pull over to the side of the road until the slow moving vehicle is an ample distance away from the test section so that the driver can maintain speed through the section. Unavoidable slow-moving vehicles (for example, a truck entering the test section ahead of the test vehicle) that force the driver to slow down should be reported to the experimenter.

X1.5.1.4 Rating forms (see Fig. X1.1) should be prepared in advance of the day of the study. The total number of forms required is equal to the number of panelists times the number of test sections. When copying forms make sure the final form is exactly 5 in. (mm) long, with ½ and 1-in. (and mm) increments marked off.

X1.5.1.5 The rating forms should be pre-coded by placing the site number and panel rater number on each form and collating the forms in the order of the sections on the route.

X1.5.1.6 One individual should be assigned the responsibility of giving the standard instructions to each set of panelists. The instructions should be read aloud and displayed on poster

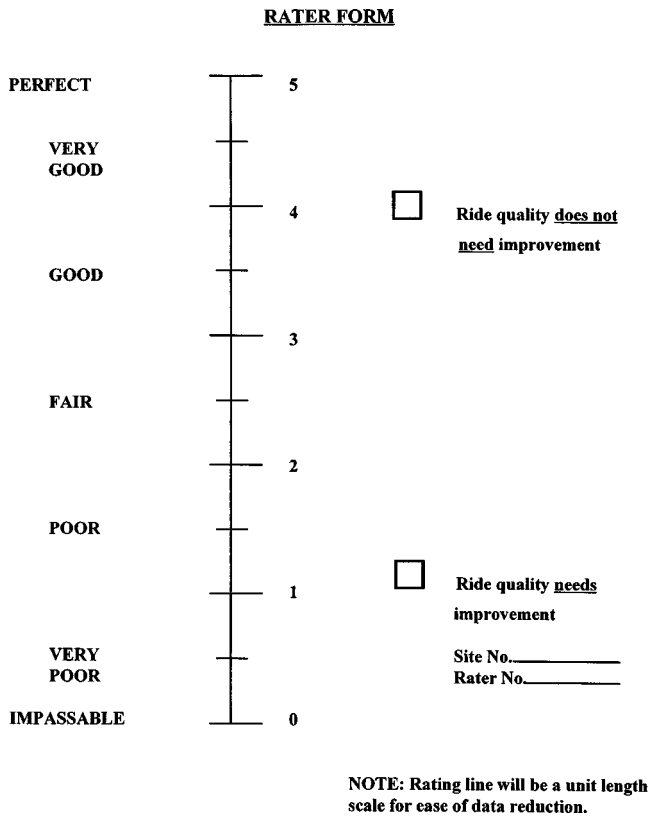

FIG. X1.1 Sample Rating Form for Panel Study

board or on overhead transparencies so that the panelists can read the instructions as well as hear them. A videotape is an alternative. A copy of the instructions should be given to each panel member.

X1.5.1.7 Determine the number of vehicles to be used. The vehicles should be the same size, type, and age, and have similar mileage. Previous studies have used Chrysler K-cars and this size is recommended. The vehicles should be inspected and maintained on a regular basis. Special attention should be paid to the suspension and proper air pressure in the tires of the vehicles. In addition, the interior and exterior of the vehicles should be clean and the gas tank full at the start of each day of the panel study.

X1.5.1.8 Arrange for a central meeting facility where panelists will meet and instructions can be given.

X1.5.2 *Procedures*—At the scheduled meeting time for the first groups, hand out instructions, rater forms, red pens, and clipboards to each panelist of a given group.

X1.5.2.1 *Rating Panel Instructions*—The rating panel instructions should be given in one room to all panelists of a given group at the same time. The rating panel instructions are very specific and should be presented to each rating panel in exactly the same sequence. For the best presentation, the rating panel instructions should be displayed on a flip chart or screen so that all panel members are seeing and hearing the same instructions. The rating panel instructions used by the investigators in the NCHRP 1–23[2,3] project are well documented and are listed below.

X1.5.3 *Other Procedures*—Once instructions are given, assign seat positions to the panelists (let them choose). Remind the panelists that they have to retain these seat positions for the entire route. Three panelists are assigned to each vehicle.

X1.5.3.1 Other topics that should be covered include: meal stops and other breaks, number of hours per day for testing, confidentiality of the data, geographical interests along the route, and any type of per diem food allowance. Answer all questions uniformly to all groups. All later groups should receive the same instructions and protocol. The panel rating study proceeds with the following steps.

X1.5.3.2 Board vehicles (a driver and three panelists).

X1.5.3.3 Drive to beginning of the route.

X1.5.3.4 Driver warns panelists a test section is approaching, announces the site number, and asks them to check to see if they have the correct form (that is, form should have the site number on it that matches the test section, as well as their rater number).

X1.5.3.5 Driver sets and maintains test speed and informs the panelists when they are in the test section by declaring, “now.” When the driver has driven through the test section and reaches the end of the test section, “stop” is declared.

X1.5.3.6 The panelists rate the site and mark the forms.

X1.5.3.7 The forms are collected by the right front panelist and placed in a box or large envelope. It is stressed to the panelists not to look at the other person’s ratings and not to discuss the ratings. (The forms are passed up to the front panelist, upside down.)

X1.5.3.8 The panelists are then taken to the next site. The driver can inform the panelists on how much time it will take to get to the next site and the geographical points of interest they will be passing.

X1.5.3.9 Repeat X1.5.3.4-X1.5.3.8.

X1.5.3.10 Take breaks as necessary, at most every 2 h. The driver should ask the panelists every hour if anyone is interested in stopping for any reason. Schedule lunch about halfway through the route each day.

X1.5.3.11 At completion of day (route) return to central site.

X1.6 *Data Reduction*—Finally, the mean of the panel ratings for each test section is calculated and the results tabulated.

X1.7 *Physical Measurements*—Any physical parameters of the highway test sections such as longitudinal profile should be measured in the same time frame as the panel ratings are collected.

X2. PANEL INSTRUCTIONS AND RATING FORM

X2.1 The following is an example of the panel instructions for conducting the highway improvement study.

X2.2 PURPOSE—To survey typical drivers to determine what they think of the quality of the ride provided by the roads selected for study. This information will be used to help decide which roads they should improve first with the limited funds available to make highway improvements.

X2.3 OBJECT OF THE STUDY—We are going to drive you over a number of roads which we believe are representative of the roads as they exist throughout the area. We will then ask you to make two judgments concerning each road. First we want you to rate the roughness or smoothness of the ride provided by each road on a scale of 0 to 5, and second, we want you to indicate whether or not you think an effort should be made to improve the ride quality of each road.

X2.4 MAKING YOUR RATINGS OF RIDE QUALITY—(A facsimile of the rating scale was shown to the subjects for this section).

X2.4.1 The first thing we want you to consider as you drive down a road is the roughness or smoothness of the ride provided by the road and then to rate it and then to rate it on scale (illustrated) which ranges from 0 to 5. You will indicate your rating by placing a small mark across vertical line of the scale at the place which you think best describes the ride provided by each road.

X2.5 DEFINITIONS OF ENDPOINTS—All roads which you will drive over in this survey will be between the two extremes. That is, somewhere between impassable and perfect.

X2.5.1 *Impassable*—A road which is so bad that you doubt that you or the car will make it to the end at the speed you are traveling-like traveling along railroad tracks along the ties.

X2.5.2 *Perfect*—A road which is so smooth that at the speed you are traveling you would hardly know the road was there. You doubt that if someone made the surface smoother that the ride would be detectably nicer.

X2.5.3 Since these roads probably do not exist you will probably not consider any road to be worse than impassable or better than perfect.

X2.5.4 In order to help you make your rating, we have included a number of words along the scale which could be used to describe how the riding sensation seems to you. For example, if you should encounter a road for which you could describe the ride as FAIR but not quite good, place your mark just below the line labeled “3” (illustrated). On the other hand, if you think the next road is still fair, but somewhat worse than the previous road, place your mark at a point which you think is the appropriate distance down in the FAIR category. To indicate small differences between the ride quality provided by the roads, you may place your mark anywhere you like along the scale.

NOTE X2.1—We are not asking you to place roads into one of the five categories! You should use small differences in the position of your marks to indicate small differences between the ride quality provided by the roads. You may place your mark anywhere you like along the scale.

X2.6 INDICATING THE NEED FOR IMPROVEMENT:

X2.6.1 After you have made your rating of the degree of ride quality provided by any particular road, we want you to check the appropriate box alongside the rating scale to indicate whether or not you think the State should improve the ride quality of the road.

X2.6.2 When making this decision you should take into account the fact that since the State only has a certain, fixed amount of money each year to make road improvements, it must determine which roads should be improved first. Therefore, before deciding on the need for improvement, you should not only consider how rough a ride is provided by each road, but whether you feel the road is important enough to be placed high on the state’s list of roads needing improvement. For example, you may ride across two roads which give identically rough rides but, if you had your choice, you would see only one of them improved because the type or character of the road seems to you to make it more worthy of improvement.

X2.7 PROCEDURE FOR SURVEY:

X2.7.1 For this survey we are going to ask you to evaluate road sections.

NOTE X2.2—You will not be rating an entire road for its ride quality. We have carefully selected small test sections to represent each road. It is these sections we want you to rate for ride quality.

X2.7.2 As you approach each section, the driver will call out the number of the section. Be sure you have the proper numbered form.

X2.7.3 When the driver says START, begin concentrating on what the *rating* of *ride quality* should be, based on how the ride feels to you.

X2.7.4 It will only take about 30 s to drive over each section, so maintain your concentration until the driver says STOP. At that point, place your rating mark on the scale.

X2.7.5 Next, while taking into account both the roughness

of the ride through the representative test sections, as well as the nature and type of the entire road, indicate whether or not you think the ride quality needs to be improved by checking the appropriate box next to the rating scale.

X2.7.6 Since some sections are only 3 to 4 m apart, make your decisions quickly and pass your form to the person sitting in the front right seat.

X2.7.7 This procedure will be repeated for each site.

X2.7.8 We will be driving over a predetermined course in an ordinary passenger car. The trip will take ___ hours the first day ___ hours the second.

X2.8 SPECIAL INSTRUCTIONS:

X2.8.1 When making your rating of ride quality, do *not* consider any of the road before or after a test section. We are only interested in a rating for a small section of road.

X2.8.2 When making your decision concerning the need for improvements, assume that the ride provided by the entire road is the same as that for the test section.

X2.8.3 Concentrate only on the ride quality provided by the roads. Don't let the appearance of the road surface influence your ratings. Judge only how the road feels!

X2.8.4 Don't be distracted by conversations in the car or by pretty scenery.

X2.8.5 Don't reveal your ratings to the other raters. There is no right or wrong answer, so don't "cheat". We are interested only in *your* opinion which is as valid as anyone else's.

X2.8.6 Be critical about the ride quality provided by the roads. If they are not absolutely perfect as far as you are concerned, be sure to give it a rating on the scale which you think best reflects the diminished quality of the ride.

X2.8.7 Be aware that there are many ways that the ride could be considered less than PERFECT. The road could:

Be so bumpy that is rattles your bones and makes your teeth chatter,

Have bumps or undulations that makes the car heave up and down as if it was a roller coaster, or

Have other imperfections in the surface which you think detract from the ride quality.