

HIGHWAY
EXTENSION
AND
RESearch
PROJECT
FOR
INDIANA
COUNTIES

Guidelines for Traffic Counts on County Roads

PURDUE UNIVERSITY—ENGINEERING EXPERIMENT STATION

in cooperation with

THE COUNTY COMMISSIONERS OF INDIANA

COUNTY HIGHWAY SERIES—No. 12

HIGHWAY EXTENSION AND RESEARCH PROJECT FOR INDIANA COUNTIES

The Highway Extension and Research Project for Indiana Counties (HERPIC) was organized at Purdue in 1959 to implement legislation by the Indiana General Assembly authorizing programs of extension and research for county highway departments throughout the state.

The financial support for these programs of extension and research is derived from $\frac{1}{8}$ of 1% of the funds made available to the 92 counties from gas taxes and license fees collected by the State of Indiana. The legislation by the General Assembly also designated Purdue University through its Engineering Experiment Station and School of Civil Engineering to develop and coordinate these programs.

The HERPIC program of extension and research provides for the preparation of manuals and bulletins setting forth recommended procedures and for regional workshop conferences with county road officials throughout the state to review typical road problems for their area. All of these activities are designed to assist and guide county highway officials in their problems of management, planning, design, and operation of county highway departments.

The HERPIC project operates as a cooperative effort between the county commissioners of Indiana and Purdue University. The program of extension and research is guided and approved by a 12-man advisory board, consisting of six county commissioners from over the state and six members from the staff of the Purdue's School of Civil Engineering. The current membership of the HERPIC Advisory Board is listed below.

HERPIC Advisory Board (July 1969—June 1971)

V. O. King, Porter County Commissioner, Chairman
E. J. Yoder, Purdue University, Vice Chairman
D. E. Bloodgood, Purdue University, Member
J. L. Brown, Wells County Commissioner, Member
M. R. Bunyard, Fayette County Commissioner, Member
R. M. Carroll, Daviess County Commissioner, Member
W. H. Gibbs, Hendricks County Commissioner, Member
W. H. Goetz, Purdue University, Member
J. M. Hayes, Purdue University, Member
J. S. McConnell, Gibson County Commissioner, Member
J. F. McLaughlin, Purdue University, Member
H. L. Michael, Purdue University, Member

Jean Hittle
Purdue University
Secretary to the Board

COUNTY HIGHWAY SERIES

guidelines for traffic counts on county roads

by
Eugene R. Russell
Research Engineer
and
Jean E. Hittle
Research Engineer

purdue university • lafayette, ind.

CONTENTS

I. INTRODUCTION	
1. General	1
2. Purpose and Scope	2
3. Acknowledgements	2
II. TRAFFIC COUNT PLANNING	
1. General	3
2. Types of Traffic Count Stations	3
3. Continuous Count Stations	4
4. Monthly Count Stations	5
5. Coverage Count Stations	5
6. Traffic Count Data Available from ISHC	7
III. ANALYSIS OF DATA	
1. General	8
2. Variations of Traffic Counts	9
3. Monthly Variations	9
4. Variations in Cyclic Patterns, A Word of Caution	9
5. Monthly Variations on County Roads	9
6. Indiana State Highway Commission Factors	10
7. Calculations of Monthly Factors	10
8. Converting 24-Hour Counts to AADT	12
9. Daily Variations	13
10. Minimum 48-Hour Count for Portable Counters ..	13
11. ISHC Factors for County Roads	13
12. Developing Local County Road Factors	14
IV. SHORT COUNTS	
1. General	15
2. A Word of Caution	15
3. Hourly Variations	15
4. Twelve-Hour Counts	16
5. Eight-Hour Counts	17
6. Variations Based on 1969 ISHC Data	18
7. Use and Application of Short Counts	18

V. OPERATION OF PORTABLE, AUTOMATIC TRAFFIC COUNTERS	
1. Personnel	20
2. Portable Automatic Counters	20
3. Preparing Counter for Operation	23
4. Traffic Counter Installation	30
5. Common Problems	40
6. Trouble Checklist	41
VI. SUMMARY	
1. Direct Benefits of Traffic Counts	44
2. Organizing a Traffic Count Program	44
3. Traffic Growth Factors	46
BIBLIOGRAPHY	47
APPENDIX A—1969 Annual Average 24-Hour Traffic Counts for 28 Permanent Traffic Counting Stations Maintained by the Indiana State Highway Commission	48
APPENDIX B—Factors to Expand 24-Hour Week-day Volumes to A.D.T.	50
APPENDIX C—Typical Data for a 7-Day Monthly Count	52
APPENDIX D—Sample Manual Count Form for an 8-Hour Coverage Station Count	53
APPENDIX E—Typical Monthly Summary of Permanent Traffic Recorder Data	54
APPENDIX F—Summary of Trouble Shooting Procedures	58

Guidelines for traffic counts on county roads

EUGENE R. RUSSELL
Research Engineer
and
JEAN E. HITTLE
Research Engineer

INTRODUCTION

1. *General:* Every county should have some sort of traffic counting program. Traffic count data, properly obtained and analysed, is essential to a sound road-planning program. It puts planning and decision-making on a realistic, factual basis. It takes much of the guesswork out of the question: "Where should funds be spent?"

Money for roads and streets must be spent in such a way that a maximum number of road-users will benefit. As road and street money always seems to be in short supply, it must be apportioned carefully. Only by having knowledge of the volume of traffic served by each road in a county can it be properly classified or grouped so that the proper apportionment of funds can be made to it or its class of road.

Obviously, all roads cannot be built to superhighway standards. Low volume roads are properly built to lower standards that are adequate for the volumes served. Usually, the classification of roads for the purpose of establishing different levels of geometric standards is done on the basis of traffic volume. The volume must be known.

Besides classification of roads for the purpose of establishing proper design standards, volume information may have additional value. Traffic volume trends or growth on a particular route or routes is one example. It may be desirable to determine peak-hour volumes at a particular location and to establish a seasonal count station to establish or verify monthly traffic variations throughout the year. It may be useful to establish a counting program to determine changes in travel patterns on routes within a county. Information in regard to vehicle-miles of travel within a county is very important and cannot be determined without information on traffic volumes.

A 1965 study (1) was conducted to estimate vehicle-miles traveled on county roads throughout the state. Information of this type is useful for good planning and should be updated periodically—5-year cycles are common—to be of continued value. As stated in the report of the above-mentioned study: “The counties, however, have little traffic volume data and a poor base on which to calculate vehicle miles of travel on county roads”—is still applicable (in 1971) to most counties. A continuing program of traffic counting and data collection is needed to keep this information current and useful.

2. Purpose and Scope: This manual has been developed to provide county highway personnel with guideline procedures for counting traffic volumes. While the emphasis is on county roads, the procedures are equally applicable to any highway, road or street; therefore, city street and state highway personnel may also have an interest in the guideline procedures outlined herein.

The section on “Traffic Count Planning” discusses general concepts of traffic counting and establishment of counting stations to obtain data for both immediate uses and long-range planning. The several types of traffic count stations necessary for the efficient collection of traffic count data are also discussed. Likewise, the traffic count data that is available from the Indiana State Highway Commission is reviewed.

The section on “Analysis of Data” presents specific examples for converting typical portable-counter data to an ADT value. These examples demonstrate the use and application of ISHC data. Likewise, the analysis of short count data is illustrated. This section will be of value to county personnel after they have obtained some traffic volume counts.

A section is also included which outlines the important aspects of automatic counting equipment. The operation of Streeter Amet portable counters is described in detail since the ISHC presently has only this make of portable counter in use and in stock.

The last section summarizes the organization of traffic count programs in relation to other phases of county highway planning and operation. This information should be of special interest to county commissioners and others who have a responsibility for making and shaping policy for the county highway department.

3. Acknowledgements: Some of the general concepts on traffic count planning have been adapted from “Traffic Volume Counting Manual,” published by the U.S. Department of Commerce, Bureau of Public Roads, May 1963. The general concepts presented in this

publication have been combined with specific examples for handling traffic count data.

Special thanks are due John E. Camardy, traffic statistics supervisor, ISHC and Dwight Kay, traffic equipment technician, ISHC, for their valuable discussion of problems associated with the use of automatic counters. Much of the section, “Common Problems” is based on suggestions by Camardy and Kay on this subject.

Portions of the Streeter Amet operation manuals have been included herein with the permission of R. T. Brumbaugh, president, Streeter Amet Corporation.

TRAFFIC COUNT PLANNING

1. *General:* Planning a traffic count program for a county highway department should take into account:

- (a) the size of the county and the predominate types of traffic that prevail; i.e., urban, suburban, resort, low-volume rural, etc.,
- (b) the number of major traffic generators in the county,
- (c) the traffic data and information already available from the ISHC that has direct use and application to the county traffic study, and
- (d) the objectives and scope of the study, i.e., priority programming, capacity-standards studies, traffic control studies, classification studies, etc.

These items will, of course, relate to traffic count planning in a variety of ways, depending on needs and problems of the particular county highway department. This section reviews the types of traffic count data needed, the traffic count data available from the ISHC, and the traffic count data normally collected by the county highway department.

2. *Types of Traffic Count Stations:* Traffic count studies over the past 30 years have demonstrated repeatedly:

- (a) that traffic volumes vary by the hour of the day, by the day of the week, and by the month of the year,
- (b) that these traffic volume variations occur in repeated cycles—by hour of day, by day of week, and by months of year, and
- (c) that these cyclic variations persist over long stretches of road and for long periods of time.

Therefore, based on these fundamental characteristics of highway

use by the traveling public, traffic volume measurement makes use of three different types of traffic count stations; these are:

- Continuous Count Stations
- Monthly Count Stations
- Coverage Count Stations

The purpose and function of each of these types of traffic count stations is covered in the paragraphs that follow.

3. *Continuous Count Stations:* This is sometimes referred to as a "permanent" count station, since its function is to count (usually by "magnetic" probes, loops, radar, or ultrasonic devices) and record by hourly intervals, the number of vehicles passing the station for long periods of time—usually several years. Assuming proper functioning of equipment, continuous count stations provide a *true record* of annual average daily traffic (AADT) for a particular station. Likewise, the count data can be analyzed for hourly, daily, and monthly fluctuations of AADT for the particular route location.

In addition to determination of long-term average trends from such stations, factors can be computed for the hourly, daily and monthly count variations, applicable to the particular station and to other route locations having similar travel characteristics. Thus, to cover the full range of state-wide travel characteristics, it is necessary to maintain several continuous count stations.

Here in Indiana the ISHC operates and maintains 28 continuous count stations. These stations and their locations are listed in Appendix A. These are strategically located over the state to cover a wide range of travel characteristics. These 28 continuous count stations are further classified into five travel groups*, each having similar monthly or seasonal factors.

These travel groups are designated as:

- Travel Group I—State Roads in Most Rural Areas
- Travel Group II—State Roads in Rural Resort Areas
- Travel Group III—State Roads in Mining Areas
- Travel Group IV—State Roads in Suburban Areas
- Travel Group V—Local Roads in Rural Areas

The monthly factors for each of these five travel groups are shown in Appendix B. Examples of how these factors are used are included in the section on "Analysis of Data."

* Additional permanent count stations are currently (1971) being established in urban areas and from these, other group factors will be available in the future.

With the amount of data available from the several continuous count stations of the ISHC, it is not anticipated that county highway departments will have any immediate need to establish any continuous count stations.

4. *Monthly Count Stations:* This is a station or location where traffic counts are taken at intermittent periods of time and on a periodic schedule that divides the year into equal parts. Here in Indiana, monthly counts are taken by the ISHC at selected stations with portable traffic counters for a period of seven consecutive days during each month of the year.

Each monthly station is matched, if possible, with the travel characteristic of one of the continuous counter groups. The monthly counts are often taken on routes where a unique monthly change in the travel characteristics is known or anticipated, such as on highways serving resort area travel.

The ISHC currently operates monthly counting stations at approximately 30 locations throughout the state. Comparison of travel characteristics at these locations with specific county routes may often be helpful in establishing the type of travel on each county route (rural, rural resort, suburban, etc.). An example of the data collected and record form is shown as Appendix C.

County highway departments with predominantly low volume rural roads need not be concerned about monthly count stations. However, where there is uncertainty about the type of travel on a high volume road, then the county highway department may consider setting up a monthly count station.

5. *Coverage Count Stations:* This is a station or location where traffic counts are taken for relatively short periods of time, normally with a portable traffic counter or manually, for the purpose of estimating the traffic volume for a particular section of road. County highway departments will be primarily concerned with this type of counting station, since the bulk of the traffic volume data comes from coverage counts. Here are some general guidelines on the location and operation of coverage count stations.

- (a) *Time Periods:* Coverage count stations may be operated continuously for periods of 24 hours, 12 hours or 8 hours. However, where portable machine counters are used, an average 24-hour weekday count should be determined by operating the count station (with twice-a-day service check) for a minimum of 48 hours during the period Monday noon

and compiles extensive data and information on traffic statistics. A considerable amount of this data has direct application to a traffic count program for county highway departments. In most cases, traffic counts are available for a portion of each county's highway system. The following categories of data and information are on file and available to county highway departments.

- (a) *Continuous Count Data:* Monthly adjustment factors are compiled for 28 continuous count stations over the state. Their locations are shown in Appendix A. From counts at these stations, adjustment or expansion factors are calculated to "expand" the counts taken at coverage count stations on the county road system. New factors are computed annually and up-dated reports issued. These factors are shown in Appendix B.
- (b) *Monthly Count Data:* Seven-day counts for each month of the year are taken at approximately 30 locations over the state for the purpose of identifying the travel characteristics of each route. That is, one needs to know the travel characteristics of a route in order to apply a factor appropriate to a group such as resort area, rural, suburban, etc.
- (c) *Coverage Count Data:* Traffic counts are taken on all of the federal-aid routes throughout the state on about a four-year cycle, including the FAS routes under county jurisdiction. This traffic count information is compiled on county highway maps and is available to county highway departments. However, the county traffic maps are not in a reproducible form and the county highway department desiring this data for its county must provide a person to hand copy the traffic counts to another map. County highway officials are urged to make the best possible use of the coverage count data available from the ISHC.

ANALYSIS OF DATA

1. *General:* It is only at continuous count stations and under ideal conditions that the true AADT (Annual Average Daily Traffic) can be computed with absolute certainty. Any count of less than a year's duration must be considered a sample. Samples of any duration, less than one year, adjusted to represent the AADT are an estimate of AADT, but if properly done such an estimate will be very close to the actual AADT.

Presented below is a means of estimating the AADT from a count for a 24-hour period obtained with a minimum of time and effort. If the procedure is followed with reasonable care, the results will be sufficiently accurate for application to county highway planning processes.

In order to extrapolate a 24-hour count to obtain meaningful results, appropriate factors are necessary. These factors are generally based on available continuous counts of the ISHC that are accurate.

2. *Variations of Traffic Counts:* Traffic volumes are subject to cyclic variations, such as monthly, daily and hourly. On any given route the cyclic variations reoccur over and over and are predictable with relatively high accuracy as long as the basic character of the travel on the route does not change. Likewise, all routes with similar travel characteristics will have essentially the same cyclic variations. Thus, if the pattern of variations is known on any one route, factors obtained from these variations can be applied to all other routes with similar travel. The nature of the cyclic variations and what is meant by "similar" travel, along with an example or two, will be explained further in the following paragraphs.

3. *Monthly Variations:* The monthly variation is generally very predictable and reflects seasonal weather as well as the socioeconomic pattern of a particular region. For example, a strictly winter resort area would be expected to have its heaviest traffic in the winter months. In Indiana, the usual pattern reflects the typical national pattern of heavy traffic during the traditional summer-vacation months and low volumes during mid-winter.

4. *Variations in Cyclic Patterns, a Word of Caution:* It must be recognized that daily traffic counts can be temporarily inflated by certain local events or conditions and thus not reflect the actual AADT—for example, special events such as a state, county or local fair, a football game, etc. Volume counts taken during such activities are not average and the application of average factors is not appropriate. These conditions are best known locally, and no volume counting for calculation of AADT should be done during such unusually high volume periods. The type of area may also be unique and travel on highways in the area may not be similar to that on any other highway where monthly factors are available. If this situation exists, special monthly counts on one or more roads in the area will be necessary to obtain appropriate factors.

5. *Monthly Variations on County Roads:* Data for monthly varia-

tions on some county roads, particularly low-volume county roads, may have a different variation than on state roads.

ISHC data records, however, are available from three continuous counting stations on county roads. These three stations represent generally a high, low and intermediate traffic volume situation. A plot of these available data is shown in Figure 1. Factors can be used from the particular curve in Figure 1 which is similar to the local road for which the AADT is desired.

6. *Indiana State Highway Commission Factors:* As previously explained, factors available from the planning section of the ISHC can be used to adjust a count taken on any day of the year to an estimate of AADT.

Data are recorded at each of the ISHC permanent count stations in such a way that a count is available for each day of the year. An hourly total is also available for each day. These data from each station are put on computer cards and a computer output showing monthly totals and averages is available. An example of this output is shown in Appendix E for Station 7047-A for January 1968. Averages shown include the average for each day of the week, a four-day average (Monday through Thursday), an average weekday (five-day average—Monday through Friday), and average hourly totals for weekdays, Saturdays and Sundays.

7. *Calculation of Monthly Factors:* From such data, factors to convert counts made during one month to an estimate of AADT can be determined. The monthly factor is simply the ratio of the average monthly volume to the actual AADT. For example, if for a particular station AADT is 200, and the average weekday count for January is 100, then the monthly adjustment factor for January is $\frac{200}{100}$

or 2. That is, the January count of 100 must be multiplied by 2 in order to "estimate" AADT. Expressed as a "formula":

$$\text{Monthly Factor} = \frac{\text{AADT for Station}}{\text{Average 24-hr. Count for Month}}$$

where, $\text{AADT} = \frac{\text{Total Yearly Count for Station}}{365}$
 = Average Annual Daily Traffic

An average 24-hour count for a month is for the days desired, i.e., average weekday, average Sunday, average Friday, etc. As an

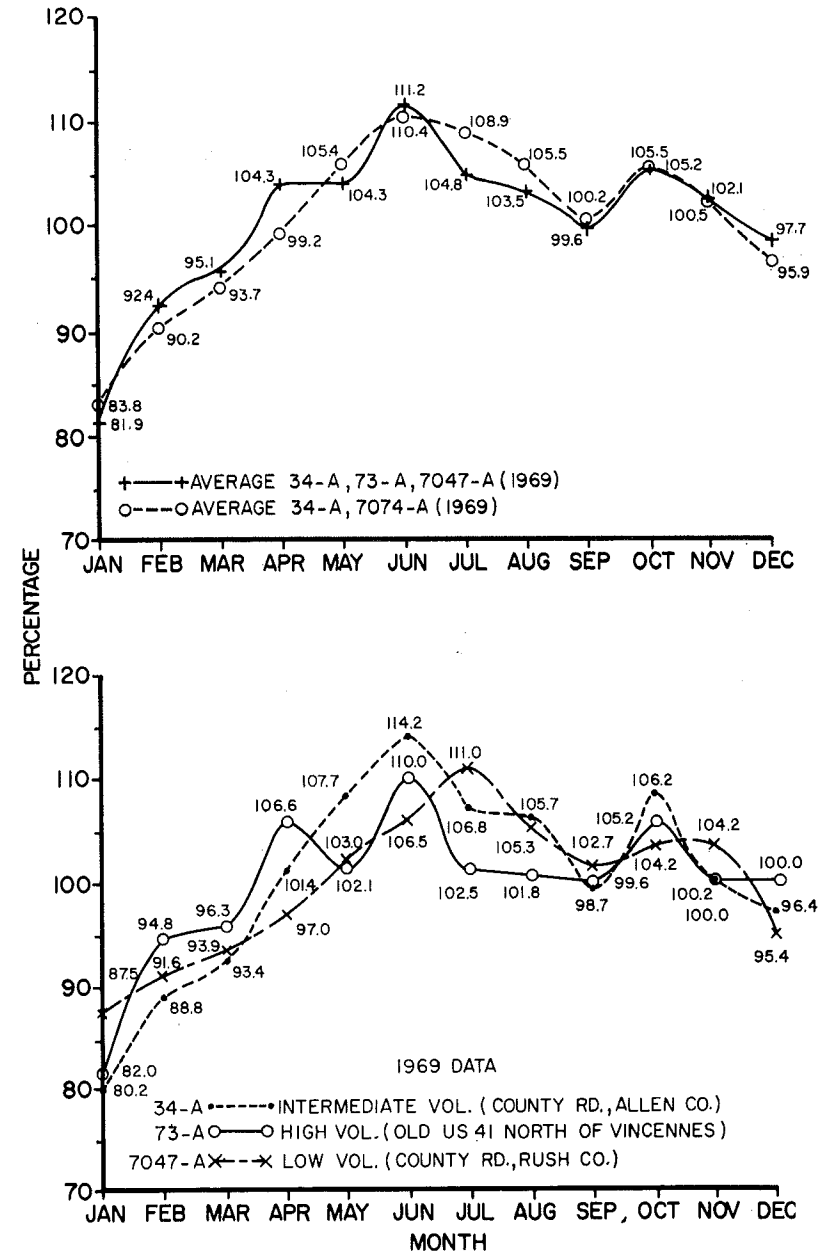


Fig. 1. Plot of Monthly Factors for Three Indiana State Highway Commission Permanent Count Stations on County Roads.

example, a portion of the worksheet used by the ISHC is presented for January for one station as follows:

EXPANSION FACTOR DATA WORK SHEET

Year: 1968		Month: January		Station: 7074-A	
*No.	Day	*Total	**Ann. Ave. 24 Hr.		
Days	Groups	Traffic	*Average	Traffic Count	***Factor
4	Sundays	714	178	281	1.579
19	M-T-W-Th	4218	227	281	1.238
4	Fridays	1097	274	281	1.026
4	Saturdays	1047	261	281	1.077

* From output sheet for January

** Yearly total divided by 365

*** Computed as: $\text{Factor} = \frac{\text{Ann. Ave. 24-Hr. Traffic Count}}{\text{Average for month}}$

Average for month

Factors for all other months are computed from comparable values taken from the record of counts compiled during that particular month.

8. Converting 24-Hour Counts to AADT

[*Different Route—Similar Travel Group*]: Now, a hypothetical example will be used to clarify the use of factors. Suppose counts are taken on another route (Route B) which is known to have the same characteristics, and therefore the same traffic variations, as the one just discussed. A 24-hour count taken on any day in January on Route B can be converted to an estimate of AADT for this route using the factors calculated above from the permanent station as follows:

Day	Route B 24-Hour Count	Factor	Estimated Annual Average 24-Hour Traffic
Sundays	180	1.579	284
M-T-W-Th	220	1.238	300
Friday	300	1.026	308
Saturday	260	1.077	280

It is obvious that the estimate of AADT differs, depending on which day the count on Route B was taken. The question then is: "Which daily volume is most stable or will most often reflect a good estimate of the true AADT?" The "answer" to this question lies in

studies that have been made of "daily" variations, and it is answered in the next two sections.

9. *Daily Variations*: A second cyclic variation is the variation from day to day within a week. The traffic volume used for most purposes is the traffic volume for the average weekday. The ISHC eliminates Monday morning and Friday afternoon as not being typical and uses the four-day period from Monday noon to Friday noon, which they refer to as the Monday-thru-Thursday average. The weekday pattern reflects work and business traffic and is quite similar from week to week.

If one assumes that the average weekday traffic in any week is adequately estimated by a 24-hour count made on any weekday, then one can use the above calculation method to estimate the AADT of a particular road from a 24-hour traffic count. Such an assumption is typically adequate, for as noted in numerous studies (2) the daily traffic volume for each of the weekdays of a week is very similar.

10. *Minimum 48-Hour Count for Portable Counters*: As stated above, any 24-hour weekday count should be sufficiently accurate for county road volumes. However, when automatic portable machine counts are made, an average should be determined by leaving the counter with a twice-a-day check for a minimum of 48 hours during the period Monday noon—Friday noon. As noted previously, this procedure makes it possible to spot "false" inputs or erratic counts for a given 24-hour weekday period. The longer the period counted, or several periods spread throughout the month, the more reliable will be the "average weekday." Or, to coin a phrase; "the more average the average weekday is, the more reliable will be the estimate of AADT."

11. *ISHC Factors for County Roads*: The following factors are recommended for use with volume counts taken on typical rural county roads in Indiana:

LOW VOLUME

(less than 500 ADT)

Based on Sta 7047-A on county road in Rush County (1970)

	Factor		Factor
Jan	1.10	Jul	0.86
Feb	1.01	Aug	0.94
Mar	0.96	Sept	1.00
Apr	0.99	Oct	1.01
May	0.99	Nov	1.04
June	0.94	Dec	1.21

INTERMEDIATE TO HIGH VOLUME
(greater than 500 ADT)

Based on average of Sta 34-A on county road in Allen County,
Sta 73-A on old U.S. 41 North of Vincennes and Sta
7047-A on county road in Rush County (1970)

	Factor		Factor
Jan	1.31	Jul	0.96
Feb	1.18	Aug	0.94
Mar	1.08	Sept	0.97
Apr	0.93	Oct	0.93
May	0.96	Nov	0.96
June	0.92	Dec	0.99

HIGH VOLUME, COUNTY ARTERIALS
(Comparable to State Highways, 1000-10,000 ADT)
Based on average of all continuous count stations on
Indiana state highways (1970)

	Factor		Factor
Jan	1.24	Jul	0.80
Feb	1.20	Aug	0.81
Mar	1.09	Sept	0.91
Apr	1.06	Oct	0.99
May	0.94	Nov	1.04
June	0.84	Dec	1.09

The factors given in Appendix B, *Factors to Expand 24-Hour Weekday (Mon., Tues., Wed., Thurs.), Volumes to AADT for "Local Roads in Rural Areas"* are averages of state count stations noted previously. Using the factors suggested above (or the "average" from Appendix B) acceptable results should be given for most county roads, although there may be cases where local characteristics are such that factors obtained by the county, either by a permanent count station or monthly count station, may be more appropriate. It should be emphasized that a county may very easily develop its own factors which may be more appropriate for any given situation. This point is discussed in the next section.

12. *Developing Local County Road Factors:* Perhaps the most practical approach for a county that wishes to develop its own monthly factors would be to do so in the same manner that monthly counts are generally taken—that is, use a portable counter, count seven consecutive days during each month, and develop factors from these data. The primary purpose of monthly count stations is to

develop factors for roads with certain traffic volume variations which fit particular routes in an area better than an average or generalized factor from a station on another type of route.

Monthly count stations sometimes provide the only way to assign, with reasonable certainty, a given route to a particular travel group or to determine that a given route stands out as being unique in its monthly travel variations. Data obtained at a monthly count station, for example, may show that a particular route's characteristics better fit other ISHC factors (from Appendix B) than those recommended above.

It should also be pointed out that another important reason for considering monthly count stations in a county is that they are valuable for determining when the "character" of a particular route is changing, e.g., a "rural" route becoming more "urban" due to subdivision growth or becoming more "resort-oriented" due to a new reservoir, etc.

SHORT COUNTS

1. *General:* Short counts, usually taken as manual counts, are feasible only because statistical studies have shown some rather consistent relationships between 24-hour counts and counts for a given segment of the 24-hour period. Thus, short counts for a portion of a day may be "expanded" with reasonable reliability to cover the full 24-hour period. This section outlines some short count relationships that are sometimes used in traffic count programs.

2. *A Word of Caution:* Under certain conditions, short counts taken manually offer some advantages from an efficiency standpoint (time-saved); however, they are subject to the vagaries of human error and behavior and offer no safeguard against "false-inputs" such as is provided by a 48-hour machine count. For these reasons, a county should only use short counts in a planned program which includes machine counters at key locations or after an experience record and data base has been developed.

3. *Hourly Variations:* A third cyclic variation that is quite predictable on a given route, or routes with the same character, is the hourly variation, i.e., variation of hourly volume within a 24-hour period. Once again, the same note of caution applies: a local event or unusual happening can substantially alter the pattern on any given date. Based on the 1954 study by Michael (2), the pattern of hourly variation on county roads differs little from state highways or city streets,

except that county roads experience more hours (1 a.m. to 5 a.m.) of almost zero volume.

The peak hours of traffic flow are 5 a.m. to 5 p.m. and approximately 50 percent of the total daily traffic use the highways during the eight hours from 9 a.m. to 1 p.m. and 2 p.m. to 6 p.m., while less than 7.5 percent use the highways between midnight and 6 a.m. The low point of traffic movement on roads of any type is from 3 a.m. to 5 a.m. Hourly variation is plotted in Figure 2 for all three of the state's continuous counters on county roads.

4. *Twelve-Hour Counts:* Instead of 24-hour counts on all county roads, a shorter time could be counted and a factor applied to extrapolate this value to a 24-hour count. It should be noted that the reliability of the final result will depend on the length and time period of the count. With twelve-hour counts from 6 a.m. to 6 p.m., the results should be entirely acceptable. Normally, such 12-hour counts are taken by manual counting. The following procedure should be used.

One or more typical roads where 24-hour or longer counts will be taken should be selected as being representative of traffic on other roads in the county. The number needed depends on the number of areas having distinctly different traffic patterns, such as in or near a town, typical rural, resort areas, or in the vicinity of any specific traffic generator that could cause shifts in the normal pattern. Short counts would then be made on the same day as the 24-hour or longer counts are being taken at all other locations where the volume is desired.

After the representative average 24-hour count is known, the shorter counts on the other roads of similar character can be adjusted to 24-hour counts. For the following example, on the basis of a 24-hour count, a 12-hour volume from 6 a.m. to 6 p.m. at that station includes 70 percent of the 24-hour count. (*70 percent assumed*)

EXAMPLE:

(a) Unadjusted 12-hour weekday count in July = 1000; then to extrapolate 12-hour counts, representing 70 percent of the volume to the 24-hour count, multiply by $\frac{100}{70}$ or 1.429.

To get the 24-hour count, unadjusted for monthly variation, multiply $1.429 \times 1000 = 1429$.

(b) The monthly adjustment factor for weekdays in July = 0.834. Now multiply the estimated 24-hour count of 1429 by the monthly factor to obtain an estimated AADT. $AADT = 1429 \times 0.834 = 1192$.

The 70 percent figure used above was more than a guess. Based on the 1954 study (2) it was shown that on the average, during the hours between 6 a.m. and 6 p.m., county roads in Indiana carry about 70 percent of their 24-hour traffic volume.

5. *Eight-Hour Counts:* In a more recent study, eight-hour manual counts were taken (1). The traffic volumes were counted between the hours of 8 a.m. and 12 noon and from 2 p.m. to 6 p.m. An expansion factor was obtained for some counties to convert the eight-hour counts to 24-hour counts. It may be worthwhile to explain how these factors were obtained.

"Five hourly recording automatic traffic counters were set out in each county. These were generally placed on paved, low-volume, state routes in order to be more closely indicative of county highway traffic. The total recorded count for the eight hours corresponding to the eight hours of manual counting was noted. The total count for the entire 24-hour period was observed."

Greater detail on how this study was conducted can be found in HERPIC Bulletin No. 9, "Annual Travel on County Highways of Indiana."

The 24-hour expansion Factor (F) was computed as:

$$F = \frac{A}{B}; \text{ where:}$$

A = total 24-hour count (sum of five machines)

B = total recorded count (sum of five machines)
for the eight hours corresponding to the
eight hours of manual counting.

The value of F obtained for some of the counties is as follows:
(8 a.m. to 12 noon and 2 p.m. to 6 p.m.)

County	Factor
Adams	2.04
Brown	1.95
Clay	2.02
Dearborn	2.04
Dubois	2.09
Elkhart	1.96
Fayette	2.09

The values above are not presented herein to be used blindly, but as a guide for the factor that one should expect. It is also interesting

to note the consistency of these factors. As a rule-of-thumb, doubling an eight-hour count (the eight hours specified above) will give the 24-hour count.

6. *Variations Based on 1969 ISHC Data:* Figure 2 shows the hourly variations calculated from 1969 data on file with the State Highway Commission on the following three routes:

Sta. No.	Location	AADT
(1) 73-A	On old US 41 no. of Vincennes	1688 (High Vol.)
(2) 34-A	On county road in Allen County	1053 (Interm. Vol.)
(3) 7047-A	On county road in Rush County	263 (Low Vol.)

Based on data taken from these stations, the following Percent Average Daily Traffic were determined. The percentage for any given time period and station is the sum of percentages taken directly from the histogram graphs shown in Figure 2.

Sta. No.	Relative Volume Class	Pct. Ave. Daily Traffic 6 a.m.-6 p.m. (12 hours)	Pct. Ave. Daily Traffic (8 hours)	
			7 a.m.-11 a.m. 2 p.m.-6 p.m.	8 a.m.-12 noon 1 p.m.-5 p.m.
73-A	High	77.5	55.2	50.3
34-A	Intermediate	71.9	51.8	47.2
7047-A	Low	75.2	54.0	54.6
Average		75.1	54.1	49.6

These values are typical of those reported in previous studies. Where more refined data is not taken locally, they can probably be used for typical rural county roads in Indiana.

7. *Use and Application of Short Counts:* Because short counts, taken manually, are subject to human error and omission, a short count program should be planned with caution. However, short counts are often expedient where traffic counts are needed on the same day for several low-volume roads. Likewise, short counts are often useful on unpaved roads where machine counts cannot be taken because of a rough or soft surface. Regardless of the purpose, short counts must be planned by an experienced person and coordinated with other traffic count data before a realistic estimate of AADT can be made for the road or station being counted.

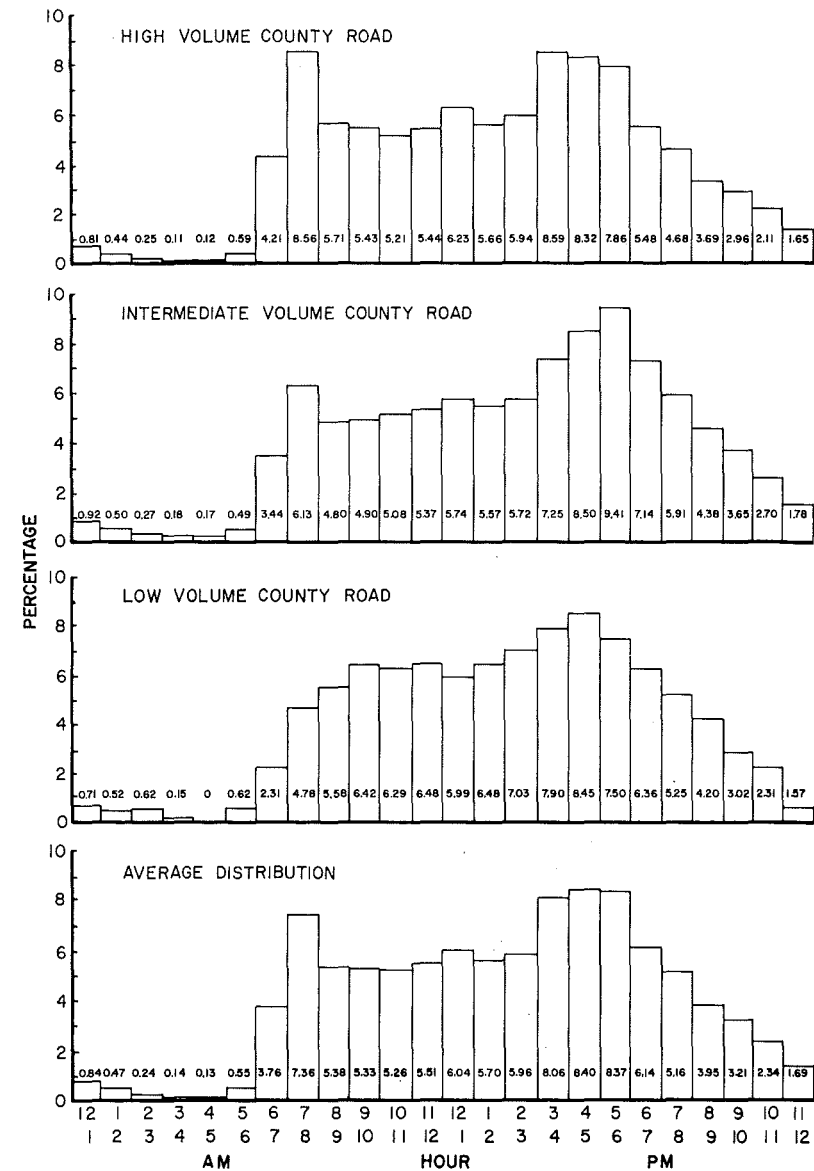


Fig. 2. Hourly Traffic Variations for Three Indiana State Highway Commission Permanent County Stations on County Roads.

OPERATION OF PORTABLE, AUTOMATIC TRAFFIC COUNTERS

1. *Personnel:* One point must be stressed from the beginning. The traffic counter is a precision instrument and **MUST** be treated as such by county highway personnel. Also, no set of instructions or list of how-to-do-it items will substitute for experience. Of course the instruction manuals should be **STUDIED**—as a starting point—but **EXPERIENCE** is going to make the difference between reliable data and poor data. A point to remember, too, is that poor data are usually worthless, since they point to incorrect conclusions.

The Indiana State Highway Commission does not consider a new employee “qualified” until after about three months of informal training. He starts out in the traffic counter repair shop watching a unit being torn down and put back together. This is followed by a period spent as an observer with an experienced fieldman. In the next phase, the new man does the field work with the experienced man watching. In the last phase the “apprentice” goes out by himself and performs the full operation, but an experienced man or supervisor later checks what has been done. The above “program” involves about a three-month period.

Most counties can justify a full-time traffic technician, by combining the traffic count program with other traffic-related functions such as records on traffic control signs, maintenance of traffic control signs, accident records on county roads and school safety programs. *In any event, it must be remembered that if the count data are to be worthwhile, some one person or a very few persons should be assigned to the operation.* Counties should not look upon the task of using portable counters as something one can do when there is a slack in his regular work—“Joe” one day, “John” the next, then “Bill,” etc. Policies of this nature are self defeating! **ONE PERSON** should be assigned the task and given opportunity to become experienced in its operation.

The following sections discuss some of the aspects of the counters themselves and highlights from the manuals of operating instructions which are available with the counters. The discussion is not intended to be a substitute for the manuals. The manufacturer’s operating manuals should be studied as a starting point.

2. *Portable Automatic Counters:* The following description is an adaptation from “Installation and Operating Instructions for Traffic Counter”* prepared by Streeter Amet Company (3). It is intended only to acquaint the reader with the machine’s components.

* Registered Trademark.

(a) *General description:* There are two types of counters:

15-MINUTE COUNTER	—prints every 15 minutes and re-sets to zero on the hour
HOUR COUNTER	—prints total each hour and re-sets to zero

There is only one basic difference between the two types of units. The 15-Minute Counter, prints the total units counted from the beginning of the hour to the end of each 15-minute period and resets to zero at the end of the hour. The Hour Counter, however, prints only the total number of units counted at the end of each hour and resets to zero.

The 15-Minute Counter offers certain advantages over the Hourly Counter, mainly because it records counts for a shorter time interval. The 15-Minute Counter makes it easier to spot “false-inputs,” erratic machine operation and irregularities in traffic flow. Likewise, the 15-Minute Counter is better suited to peak volume studies. The 15-Minute Counter is therefore *recommended* since it will better serve the overall needs of county traffic-count programs. The ISHC uses 15-Minute Counters almost exclusively.

Portable, pneumatic-actuated machine counters (3) are powered by storage batteries that need charging about once a month—on the average. Hourly totals are printed on a continuous strip of paper (See Figure 5) which is removed from the machine and the figures transcribed to permanent office records.

A vehicle wheel passing over the $\frac{5}{8}$ -inch rubber tube closes a pneumatic switch which actuates the counter mechanism. The rubber tube must be placed on a hard, reasonably smooth surface at points where the traffic is moving in a straight path. The tube may be placed to count traffic in two directions, but should not cover more than three lanes. Machine counts become unreliable at volumes in excess of about 2,000 vehicles per hour per machine.

The machine records each two-actuations as one vehicle. For this reason, a correction factor may be necessary on streets and roads carrying large numbers of multi-axle trucks.

A machine counter weighs approximately 85 pounds and can be placed and maintained by one man if necessary. The placing and servicing of eight to twelve machines used for 24-hour counts represents the average amount of work that one man can accomplish in a day.

(b) *Description of Components:* The following description should help acquaint the reader with the general principles of the operation of a counter.

ROADTUBE—transmit air-impulses to diaphragm

The roadtube consists of a length of heat-resistant, gum-rubber tubing. As tires from vehicles pass over the roadtube, they create pressure waves which pass through the tubing to the diaphragm assembly located in the traffic counter. When replacements are needed, standard tubes meeting the manufacture's specifications or ISHC specifications must be used. The ISHC uses a hose with an inside diameter of about $\frac{1}{4}$ " , a little larger than the hose supplied with the machine; however, it meets all other specifications. (See also ISHC specifications for purchase of Rubber Traffic Tubing, page 38.)

DIAPHRAGM ASSEMBLY—converts air-impulse to electrical contract closure.

A diaphragm assembly is used to convert pressure waves of air from the roadtube to electrical pulses for operating a transistorized circuit. An indicator dial on the diaphragm assembly is used to adjust the sensitivity of the diaphragm for proper operation.

TRANSISTORIZED MODULE—advances magnetic counter when electrical impulse received.

A transistorized circuit is used to operate a magnetic counter. An electrical pulse received from the diaphragm assembly activates the transistor circuit, causing the magnetic counter to advance one half of a count (two half-counts equal one number).

MAGNETIC COUNTER—moves numbered printwheel to record count total.

A magnetic counter is used to move the numbered print wheels according to the pulses received. Each time two electrical pulses are received from the transistorized circuit, the print wheels are advanced one full digit. The magnetic counter records traffic moving at normal highway speeds.

CLOCK and PRINTER—clock activates printer arm periodically to record total from print wheel, then to reset the printer wheel.

The clock portion of the clock-printer assembly is an eight-day mechanical clock with two main springs. The clock will turn a motor switch "ON" every fifteen minutes or each hour, depending upon the type of counter being used. The motor switch is connected to the print motor. The motor activates a print hammer producing a printed record on paper tape. As the print ham-

mer resets, the paper tape and inked ribbon are advanced. After completion of the print cycle, the print motor is turned off. The print cycle will not start again until the print motor switch is turned on by the clock.

POWER SUPPLY—a standard 6 volt, 110-amp/hour, wet-cell battery is generally used to power counter.

(c) *General Arrangements of Components*: Figure 3 shows the counter with the lid and counting mechanism opened showing the battery housing underneath. The numbers (4, 5 and 6) and arrows on Figure 3 shows approximately the orientation of Figures 4, 5 and 6.

Figure 4 shows the battery housing and battery connections. Figure 6 shows the main components of the counting mechanism and is used herein primarily for the purpose of orientation of these components. The arrows and corresponding numbers show the location of subsequent figures showing closeups of these areas as follows:

Figure	Description
7	Transistor Module
8	Diaphragm Reset
9	Terminal Board

3. Preparing Counter for Operation

(a) *Battery Installation* (Refer to Figure 4): A standard 6 volt, 110-amp/hour, wet-cell battery is used to power the counter. The battery should be fully charged with a reading of 1250 at 72°F on the hydrometer. Install the battery into the lower part of the case.

After making sure the battery terminals are clean and free of corrosion, connect a cable from the insulated negative (—) terminal of the counter to the negative (—) terminal of the battery. Also, connect a cable from the counter chassis to the positive (+) terminal of the battery. These connections are illustrated in Figure 4.

NOTE: BE SURE THAT CONNECTIONS ARE CLEAN AND TIGHT OR COUNTER MAY NOT OPERATE. NEVER LAY A COUNTER ON ITS SIDE WITH BATTERY IN HOUSING. IF BATTERY IS TIPPED, SPILLING ACID ON COUNTER MECHANISM OR CASE, WASH OFF IMMEDIATELY. BAKING SODA WILL HELP NEUTRALIZE THE ACID.

(b) *Diaphragm (Road Switch) Adjustment* (Refer to Figure 8):

- (1) Turn the power switch "ON."
- (2) Rotate the diaphragm dial slowly clockwise until the counting mechanism energizes.

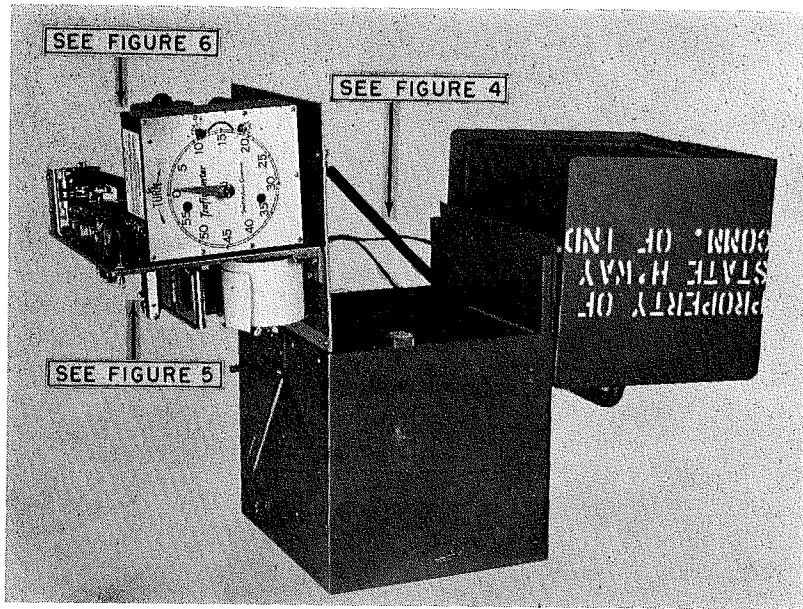


Fig. 3. General Orientation of the Main Components of the Counter.

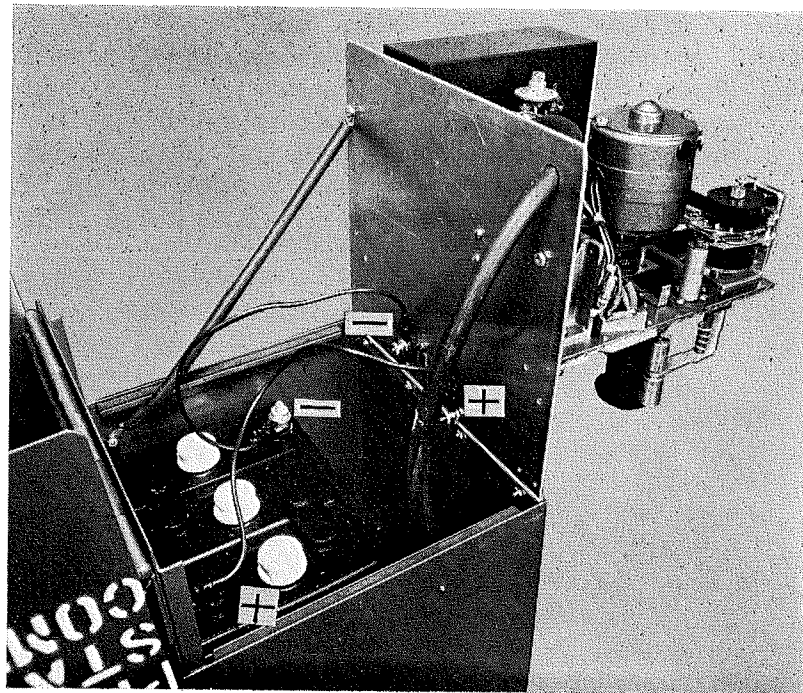


Fig. 4. Six-Volt Battery Power Source and Connections.

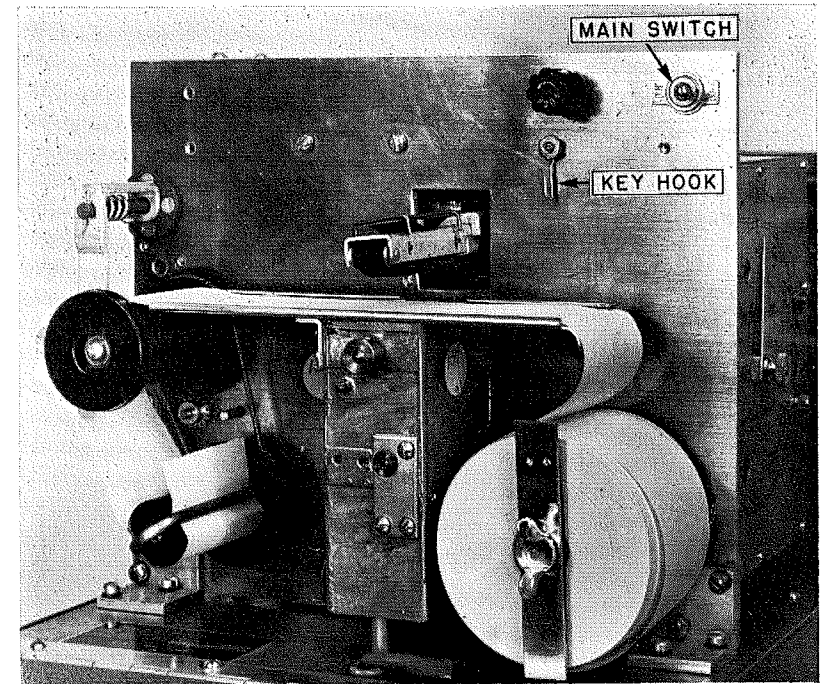


Fig. 5. Front View of Printing Mechanism.

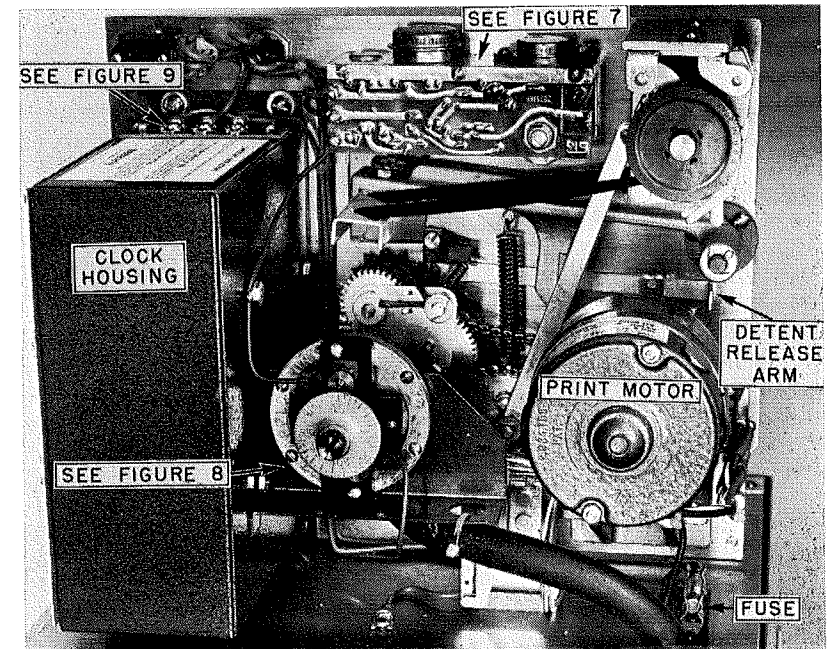


Fig. 6. Rear View of Printing Mechanism.

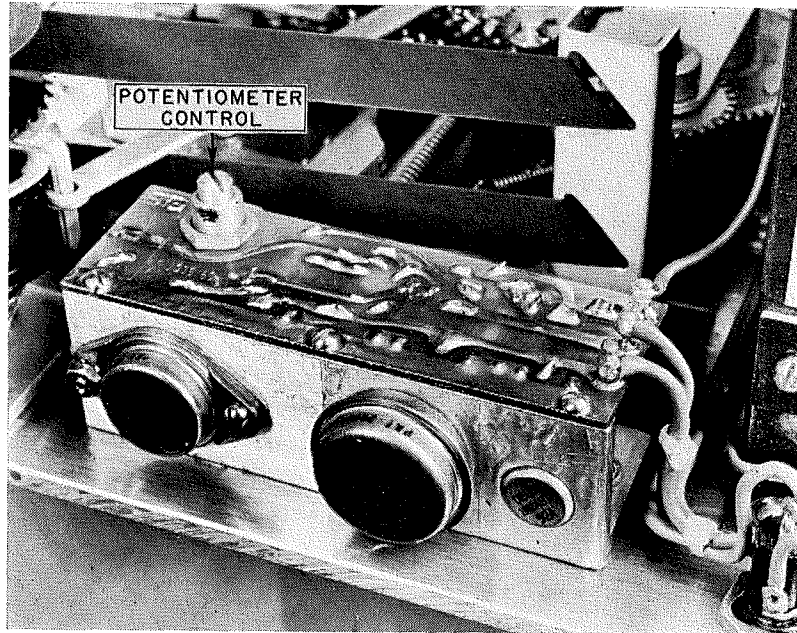


Fig. 7. Detailed View of Potentiometer.

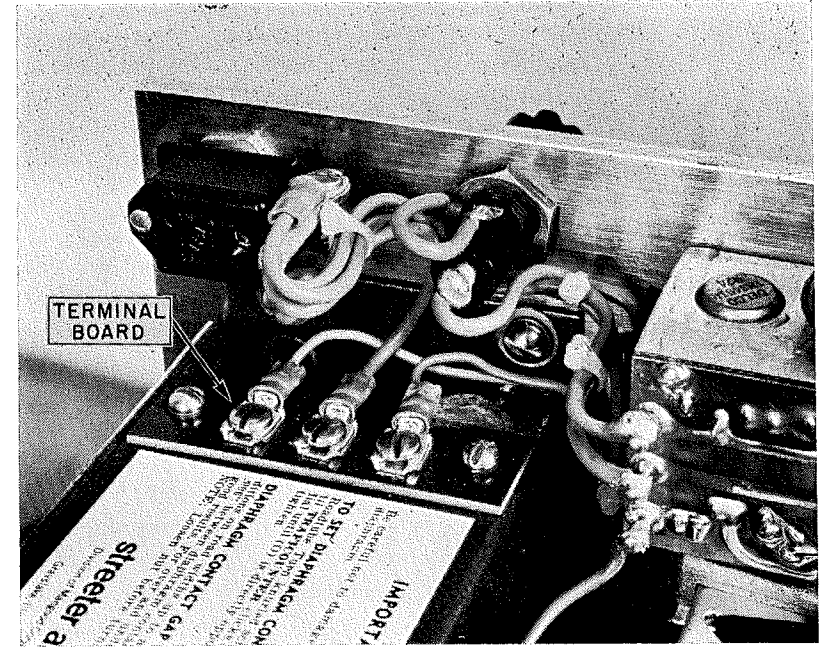


Fig. 9. Detailed View of Terminal Board.

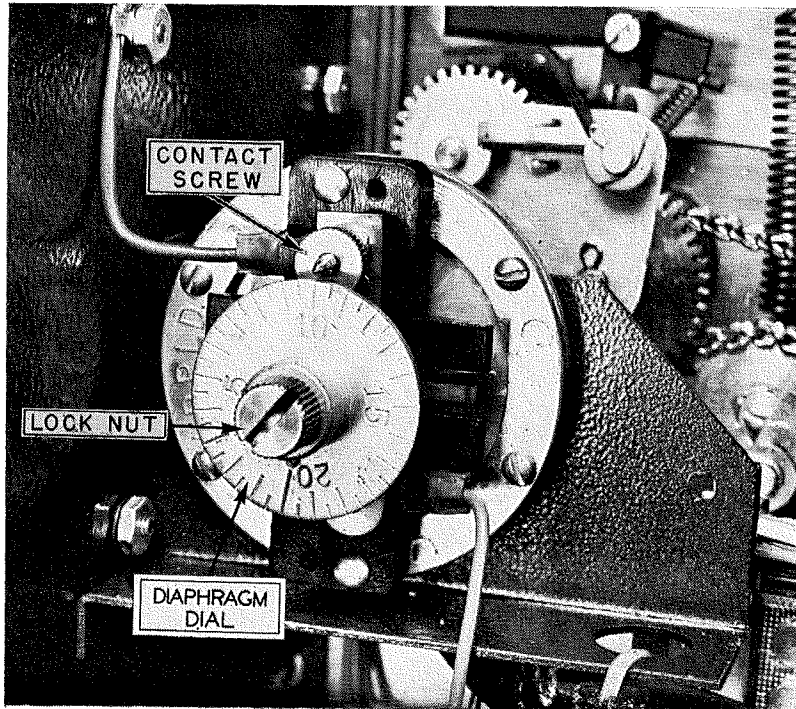


Fig. 8. Detailed View of Diaphragm Settings.

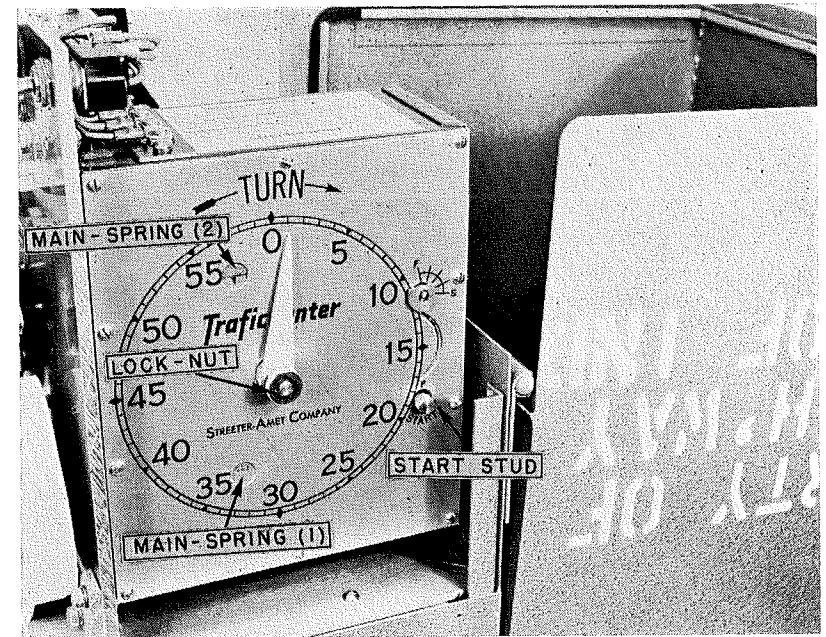


Fig. 10. Clock Details.

(3) The dial indicator should read zero. (If it does not read zero, loosen locknut about $\frac{1}{4}$ turn while holding the dial and then rotate dial [only] to zero. KEEP CONTACT SCREW FROM TURNING.) Tighten locknut with dial held in new position.

(4) Rotate dial counter-clockwise to No. 5 position.

(c) *Synchronize Clock and Printer Assembly:* This is a critical item in the calibration of a traffic counter. The step procedure outlined here was developed to serve the needs of the beginner, synchronizing the clock and printer assembly (for the first time) on a 15-Minute Counter.

A little experience will demonstrate, however, that the clock and printer assembly can be also synchronized by other procedures. The procedure set forth in the manufacturer's manual, for instance, synchronizes the clock and printer in a slightly different way.

The clock and printer may be synchronized at the county highway shop or garage or at a roadside count station. For the beginner, however, it is recommended that the calibration be carried out two or three times at the shop before an actual counter installation is made. In this way, the installer gains self-assurance of what is required and when the clock and printer are truly synchronized.

(1) Turn power switch "OFF."

(2) Wind both main springs (1) and (2) in clock assembly. (See Figure 10.)

NOTE: The winding key should hang on a small hook on front of vertical face plate. *Worn keys should be replaced to prevent damage to the winding arbor.*

(3) Rotate "START" stud on the face of the clock counter-clockwise to start the clock mechanism. (See Figure 10.)

(4) Install roll of paper tape in machine. (See Figure 5.)

(5) Loosen lock-nut on clock-hand $\frac{1}{4}$ turn.

(6) Rotate clock-hand slowly (clock-wise); position clock-hand at the "0" or 60-min. position. Tighten lock-nut on clock-hand.

(7) Turn power switch "ON"; this will energize the print hammer, recording the settings of the six print wheels. Reading from left to right on the tape, print wheels 1 and 2 record time (see Figure 11); print wheels 3, 4, 5 and 6 record traffic counts. Turn power switch "OFF."

(8) Alternately turn power switch from "OFF" to "ON," until the hour wheel (No. 1—left) advances to the next higher (hour) number. The hour cycle of the clock and printer assembly are synchronized when the power

switch is "ON" and the next higher hour is showing on the tape.

(9) Keep power switch "ON" and *check* synchronization as follows:

(9-a) Loosen lock-nut on clock-hand $\frac{1}{4}$ turn.

(9-b) Turn clock-hand slowly (clockwise), pausing at the 15-min., 30-min., 45-min. and 60-min. positions to allow completion of print cycle.

(9-c) At this point, print wheels Nos. 3, 4, 5 and 6 will have re-set to zero.

(9-d) On the return to the "0" or 60-min. position, the hour wheel (No. 1—left) should again advance to the next higher number.

(9-e) If the synchronization does not check, repeat step No. 8 and re-check.

(9-f) The hour cycle of the clock and printer assembly are synchronized *only* when the clock-hand passing the "0" or 60-minute position advances the printed hour to the next higher number.

(9-g) Tighten lock-nut on clock-hand at "0" position.

(10) Remove paper tape from guide slot so as to expose print wheel.

(11) Pull detent release arm (see Figure 6) to free print-wheel mechanism.

(12) Rotate No. 1 (hour) print wheel to the current hour of the day; for example if the time is 8:20 a.m., set the hour wheel with 8 in the top position. (See Figure 11.)

(13) Release detent arm. (See Figure 6.)

(14) Position No. 2 print-wheel to A (a.m.) or P (p.m.) for current hour of day. (See Figure 11.)

(15) Replace paper tape in guide slot and attach to rewind spool as per Figure 5.

(16) Loosen lock-nut on clock-hand $\frac{1}{4}$ turn and *carefully* move indicator hand slowly in clock-wise direction to the current clock time and tighten lock-nut. At 8:20 a.m., as in Step 12, the hand is positioned at 20, pausing at the 15-minute position for completion of print cycle.

(17) PRECAUTIONS:

(17-a) DO NOT loosen lock-nut on clock-hand more than about $\frac{1}{4}$ turn.

(17-b) PAUSE at 15-min. (also 30-min. and 45-min.

positions if necessary) to allow for completion of print cycle.

(17-c) DO NOT move hand in counter-clockwise direction; this will upset the synchronization.

(17-d) BE SURE TO TIGHTEN LOCKNUT ON CLOCK-HAND.

(18) The traffic counter is now ready for installation. As noted before, preparing the counter for operation may be done in shop or field. For the beginner, a few "trial-runs" in the shop is advisable in order to get acquainted with the component parts and their operation.

(19) The preceding steps outline the synchronization of clock and printer for a 15-Minute Counter. The calibration of an Hour-Counter is much the same, except Steps 8 and 9 are omitted.

4. *Traffic Counter Installation:* Before installing the counter, check: (a) Roadtube for dirt and holes; (b) Batteries for proper strength.

No matter where or how many times the counter is set up, always check the roadtube for cuts, holes and dirt. Blow the inside clean with an air hose. The counter will not work if the roadtube leaks or if the roadtube is clogged.

(a) *Ideal Roadtube Installations:* Proper installation (4) of the roadtube should, if at all possible, allow heavy, wide-tired vehicles, such as trucks, buses, etc., to strike the roadtube at a point furthest from the counter to eliminate double counts. In addition, the roadtube should be placed at a right angle or angled slightly against traffic flow.

(b) *Location:* In all locations, the counter must be chained and locked (in an upright position) to a tree, sign post or utility pole, (See Figures 13 and 19.) Make sure the chain is sufficiently snug, so that the counter cannot tip over. The side of the road across from the counter is called the *far-side*. The side of the road that the counter is on is called the *near-side*.

(1) *Highway without center median:* Chain the counter to a tree, sign post or street lamp at the side of the road, preferably the side away from the traffic flow for added protection. Select a spot where the road is straight and at least 100 feet away from traffic lights, stop signs or intersections.

(2) *Highway with center median:* When installing on a highway with a center median, place the counter in the

median when possible. Since most heavy trucks travel on the outside lanes, this procedure will decrease the chance for overcounting. A further explanation of the effect of trucks will be given below.

(c) *Roads and Streets Without Curbs* (Refer to Figure 12):

(1) Place the counter next to a tree, sign post or lamp post. This is the near side.

(2) Lay the tube across the highway.

(3) On the far side of the road, plug the end of the roadtube with a round head screw.

(4) Slide a hose clamp over the far end of the roadtube with anchor stem projecting beyond end of the tube. (See Figure 14.) Tighten the clamp around the roadtube and plug-screw by turning the small screw on the side of the clamp.

NOTE: The ISHC prefers to use a "Chicago eye-bolt," $\frac{1}{8}$ " larger than the inside diameter of the hose. The "eye" is then anchored to the shoulder approximately 1-2 feet beyond the edge of pavement (on the far side) by means of a long bridge spike or rod driven through the "eye." This arrangement eliminates the need for a clamp as described in items 4, 5 and 6. (See Figure 15.)

(5) If the ground is hard, drive a spike through the hole in the end of the clamp, into the ground. If the ground is too soft to hold the spike firmly, drive a stake instead. (See Figure 16.) Fasten the clamp to the stake with a screw. (Here again, the ISHC prefers using a 10'-12" bridge spike driven through the eye of the Chicago eye-bolt in lieu of a stake.)

(6) Return to the near side. Slide a second clamp over this end of the roadtube. Be sure the anchor stem of the manufacturer's standard clamp points away from the edge of the road on the near side. Attach clamp to the ground at least one foot beyond the edge of pavement on the near side. Make certain that the roadtube slides through this clamp freely. (See Figure 17.)

(7) The roadtube should be straight across the road or at a slight angle as recommended in the manufacturer's manual.

(8) Pull the roadtube through the clamp until it has stretched 10 percent. This means a stretch of: one foot if the road is 10 feet wide, two feet if the road is 20

feet wide or three feet if the road is 30 feet wide and so on.

- (9) After stretching the roadtube the right amount, wrap enough tape around the roadtube next to the clamp, so that the roadtube cannot slide back through the clamp. Make certain that the clamp is anchored in such a way that the roadtube is not pinched shut, either at the clamp or at the edge of the pavement.

NOTE: On the near side, the ISHC uses a U-clamp attached (nailed) to the pavement in combination with a steel nut and tape (packing) around the roadtube. (See Figure 18.) This method is reasonably effective and trouble-free providing a heavy-duty clamp is used that is not flattened by wheel loads.

- (10) When the road width is greater than the length of the roadtube, it will be necessary to extend it by using a roadtube extension sleeve. The extension sleeve should not be used on a traffic-bearing area. On narrow roads, keep any additional roadtube length coiled around the counter.
- (11) Attach the free end of the roadtube over the end of the pipe on the side of the counter.
- (d) *Roads and Streets With Curbs* (Refer to Figure 19):
- (1) The roadtube must be held flat against the road at every point. For this reason the roadtube must be attached to the road itself and not to the ground beside the road.
 - (2) Follow the instructions for roads and streets without curbs except as follows: Do not drive spike or stake into the ground. Instead, find a crack, expansion joint or mortar joint in the pavement next to the curb. Drive a masonry spike through the hole in the end of the clamp into crack, expansion joint or mortar joint.
 - (3) Bring the free end of the roadtube up and over the curb and attach it to the pipe on the front side of the counter.
- Caution:* Do not put the hose across walks or paths where pedestrians may trip and be injured.

(e) *Putting Counter in Operation:* Assuming that counter has been prepared for operation and the roadtube has been properly installed, the counter installation is completed with these additional steps:

- (1) Set the transistor module circuit control (potentiometer control shown in Figure 7) halfway between full clockwise and full counter-clockwise.

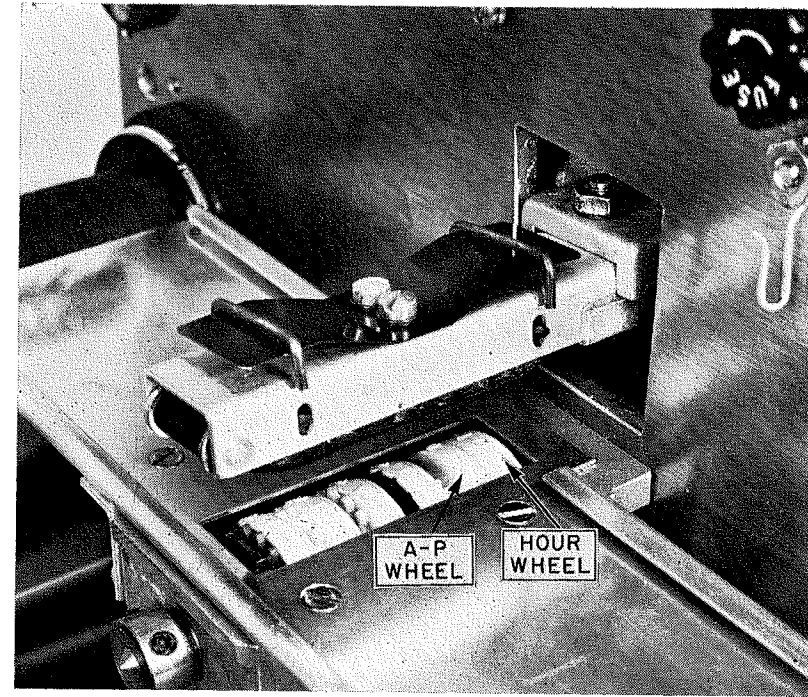


Fig. 11. Detailed View of Print Arm and Typewheels.

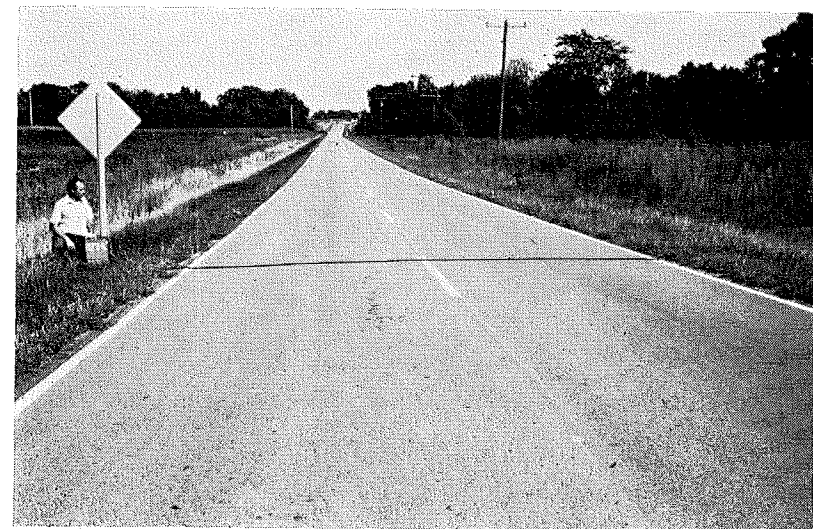


Fig. 12. Typical Arrangement for Automatic Traffic Counter on a County Road.

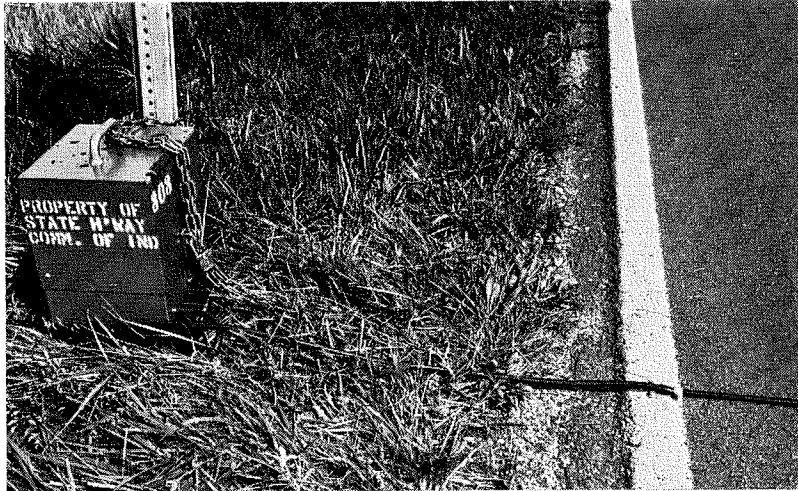


Fig. 13. Counters must be chained and locked in an upright position to a tree, sign post or utility pole. Chain must be snug so counter cannot tip over.

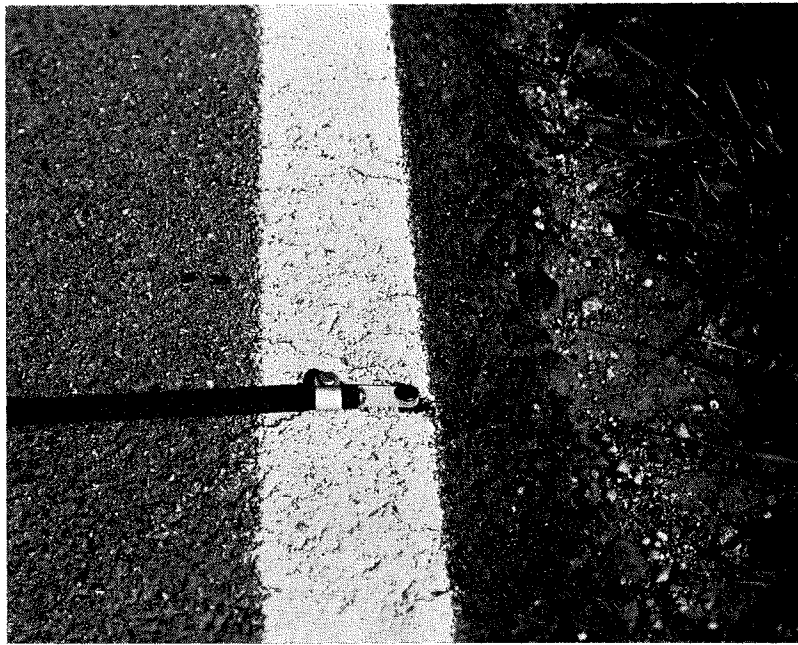


Fig. 14. Detail View Showing Hose Clamp and Roadtube Anchored With a Spike Nail at Far-side of Pavement.



Fig. 15. Detail View Showing Chicago Eyebolt and Roadtube Anchored With Spike Nail at Far-side of Pavement.

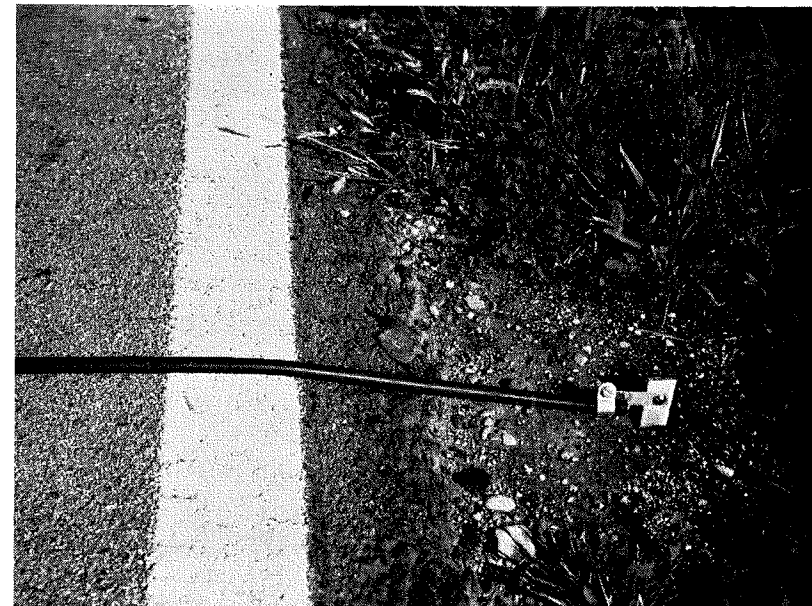


Fig. 16. Detail View Showing Hose Clamp and Roadtube Anchored to an Iron-angle Stake Driven in Shoulder at Far-side of Pavement.



Fig. 17. Detail view of roadtube anchored to near-side of pavement by means of a hose clamp. Small washers are used as spacers to hold the clamp open so the roadtube will slide freely through the clamp. Tape wrapped around the roadtube on the near-side of the clamp holds the roadtube tight.



Fig. 18. Detail view of roadtube anchored to near-side of pavement by means of a heavy-duty U-Clamp and a nut slipped over the hose. Tape wrapped around the roadtube on the near-side of the nut holds the roadtube tight.

- (2) Wrap excess length of roadtube around counter and connect (or re-connect) free end of roadtube to pipe on front side of counter.
- (3) At this point the counter should be operational. New counters are pre-set at the factory for average conditions, but may have to be field-adjusted to eliminate over-count and under-count. [See Sensitivity Adjustment, p. 34, section (e).]

(c) *Roadtube*: The hose itself should be approximately perpendicular to the traffic flow. The Streeter Amet manual (4) recommends that the hose be at an angle of 9° against traffic flow. This angling does not appear to be critical. The hose will bow somewhat as traffic moves over it anyway. The hose can be placed in a small filled joint in concrete pavements. It should not be placed on soft gravel or rough surfaces.

Some general pointers can be given on care of the hose itself. Of course, the *hose must not leak*. One quick check can be made by blowing smoke into the hose. The hose is manufactured with a soapstone coating on the inside so that the walls of the tube will not stick together as traffic goes over it. If the hose walls should stick, even momentarily, counts will likely be lost; therefore, the soapstone is necessary. However, as the tube gets used, the soapstone tends to roll up and clog the hose.

Sometimes it is necessary to splice a hose when a longer piece is necessary. DO NOT splice the section that is in the roadway because it generally will not last. Also, when holes do show up in a tube, DO NOT patch the hose. Splicing should be in the lead-in portion or extra tube which is generally kept on the near-side around the counter.

It is best to keep the hose length under 100 feet. Longer lengths will work; however, the longer the hose the more precisely the counter has to be adjusted and more trouble is likely to occur. Another word of caution, short lengths of hose can cause trouble. For example, if the hose is extended directly out from the counter for only a short distance there is a high probability that it will "double-count."

As explained previously, when a tire goes over the hose it starts an air-pressure wave *toward* the counter where it is converted to one-half a count. An air pressure wave is also started *away* from the counter which travels toward the plugged end of the tube. If the tube is short, this wave will be reflected from the plugged end (back toward the counter), and register as a second set of tires. Thus, one

set of wheels can be "double-counted." Large, slow-moving vehicles with large tires tend to double-count especially when passing in the lane nearest the counter.

(d) *Replacing Roadtube:* Being subject to the stress and abrasive action of traffic, the roadtube often has a relatively short life. Therefore, it is recommended that each counter have four or five spare roadtubes for emergency replacement. While spare roadtubes are available through the counter manufacturer, it may be desirable and expedient to purchase replacement tubing from other vendors.

In purchasing spare roadtubes, the rubber tubing for same must be:

- (1) correct size, wall thickness and length to properly operate counter,
- (2) formulated to provide adequate resiliency at both high and low temperatures, and
- (3) cured and processed in such a way that the inside wall surfaces do not stick together.

The following is an ISHC specification that has proven reasonably satisfactory in the purchase of roadtube replacements. It is included here as a guideline for Indiana county highway departments.

SPECIFICATION FOR PURCHASE OF RUBBER TRAFFIC TUBING

Rubber traffic tubing having $\frac{9}{16}$ " O.D. x $\frac{1}{4}$ " bore, with tolerance of $\frac{1}{64}$ " for inside diam. and $\frac{1}{32}$ " for wall thickness. The tubing shall be extruded in minimum lengths of 50'. The rubber tubing shall contain not less than 65 percent crude rubber by weight, with sufficient antioxidant to counteract deleterious effects of sunlight, and the remainder of reclaimed rubber and other filler usually used in manufacturing such tubing. The tubing must be capable of transmitting air impulses to counter mechanisms at temperatures of 20 degrees below zero and 175 degrees above zero (Fahrenheit). The tubing must also be capable of withstanding impacts of heavy vehicles. The material must be so compounded or mixed that the tubing will not become brittle at low temperatures or stick at high temperatures.

(e) *Sensitivity Adjustment:* There are two general methods to prevent or minimize double-counting. One is to avoid using short lengths of hose by using a "leader" or extra length on the counter. The other involves proper setting of the sensitivity of the counter.

The following procedure is taken from the Streeter Amet manual (3):

If the counter overcounts, proceed as follows:

- (1) Move the diaphragm dial to a maximum setting that will detect vehicles in the farthest lane.
- (2) Move dial back to $\frac{1}{2}$ of this maximum setting. For example, if the maximum setting is "20," set diaphragm dial to "10."
- (3) Rotate controls on transistor module circuit slowly until overcounting stops.
- (4) If overcounting continues, increase the diaphragm dial and transistor module control settings.

If the counter undercounts, proceed as follows:

- (1) Make sure diaphragm dial is on number 5 position.
- (2) Slowly turn transistor module control until undercounting is eliminated.

The following check is suggested. The counter should properly count a slow-moving large truck in the near lane and, also, a fast-moving light vehicle in the far lane. A frequent fault on the part of installers is that they do not check the machine operation for a long enough period of time to be assured that all components of the counter are working properly.

(f) *Clock Operation:* The clock is an eight-day, spring-wound clock. A clock should be expected to keep good time for a year to 18 months. After that, if they no longer operate well, they must be returned to the clock manufacturer for reconditioning. The later models should not be wound tightly, as overwinding sometimes causes malfunction. With older models, this was no problem, but to be safe, winding should be done with care. The details of winding the clock are straight-forward and can be found in the manual; they will not be repeated here.

(g) *Ribbon Assembly:* A detailed sketch (not included here) of the ink ribbon spools, print-hammer and hammer-arm assembly is presented in the Streeter Amet manual (3). The hammer-arm assembly should be checked for cracks. The arm occasionally cracks in the vicinity of the spring-clip holders. When this occurs, the arm may not put enough pressure on the print-hammer and poor printing can result. Also, for good printing it is important that the ribbon be placed through the bridge as shown in the figure in the manual.

The ISHC uses a specially processed paper that prints without a ribbon.* Thus, if the ribbon fouls up, the data are still printed legibly. It also gives better results in extreme cold weather.

(h) *Servicing and Maintenance*: One last point must be stressed. When machines are in use TWICE-A-DAY SERVICE IS ESSENTIAL. (See Figure 22.) The main point is that to put out a counter and leave it for a long period, perhaps even 24 hours, without checking is a waste of time. Other maintenance personnel, for example, those involved with snow removal, grass cutting or grading operations must be cautioned to be careful around traffic counters.

5. *Common Problems*: This section is a discussion of problems commonly encountered in actual field operation and some suggestions to avoid trouble. Detailed pictures and other illustrations are available in such manuals as "Trafficcounter Installation and Operating Instructions," (3) and these should be studied. On the last page of this particular manual is a *Trouble Checklist*. This list will be presented below with some comments for clarification.

(a) *Personnel*: There is no list or manual which can be used as a substitute for experience. This fact has been stated before but one example will be given here for emphasis. The first statements made in the trouble checklist involve checking for: (a) burned out fuse, (b) dead battery, (c) loose battery connection.

These instructions, would seem to involve no more than common sense. However, dozens of machines are brought to the ISHC repair shop by city and county personnel every year from all over the state, for "repair" WITH NOTHING WRONG WITH THEM, except a burned out fuse, dead battery or loose connection.

The basic answer to this problem is, as stated previously, let one person gain enough experience with the counter so that checking for these minor problems becomes a standard operating procedure.

(b) *Location*: The counter should be located on a straight stretch of road away from intersections, traffic lights, and other areas where braking action or turning movements are likely to occur. There should be no large speed deviations, i.e., all vehicles, in all lanes being counted, should be moving normally.

Two illustrations which relate to the above suggestions involve a traffic signal with: (a) two lanes on one-way operation and (b) two lanes on two-way operation. In the first case, illustrated in Figure 20, there will probably be more traffic and more slow-moving vehicles

* Information on obtaining this type of paper can be obtained from various suppliers, the counter manufacturer or the ISHC.

in the right lane. Thus, if the counter is on the right there is more chance that right-lane traffic will block the hose, losing some counts from the left lane.

In the second case, illustrated in Figure 21, the reasoning is about the same. Cars stopped for the light in the right lane can block the hose so that when the light turns green, counts of the opposing left-lane traffic will be lost and also counts of turning traffic before the light changes.

6. *Trouble Checklist*: The following trouble-check list is adapted from the Streeter Amet manual (3):

- (a) *Counter does not operate with power switch "ON"*; check:
 - (1) Fuse, if burned out, replace.
 - (2) Battery leads for proper connections.
 - (3) Battery potential.
- (b) *Printer operates but counter does not*; check:
 - (1) Roadtube for clogging or obstructions.
 - (2) Transistor module for loose connections.
 - (3) Diaphragm assembly for cracked or punctured membrane or possible bent contact loop assembly.
- (c) *Counter counts but does not print*; check:
 - (1) Clock is fully wound and operating.
 - (2) Micro-switch in clock is properly adjusted and operating.
 - (3) Input leads to print motor.
 - (4) Print motor for operation. This can be done by connecting the print motor directly to the battery with jumper wires.
- (d) *Printer double prints*: check the print motor stop cam for adjustment.
- (e) *Printer counts wrong or gaps between numbers*: check print wheels for wear.

Presented in Appendix F are troubleshooting hints from another Streeter Amet manual, "Troubleshooting Procedures, Repair Instructions and Recommended Spare Parts List." These may be of help, also.

For further emphasis it will be repeated here that there is no substitute for experience. Any county using counters must realize that they must make every effort to train someone to become adequately knowledgeable and then give him the opportunity to gain experience.



Fig. 19. Typical arrangement of counter on road or street with curbs.

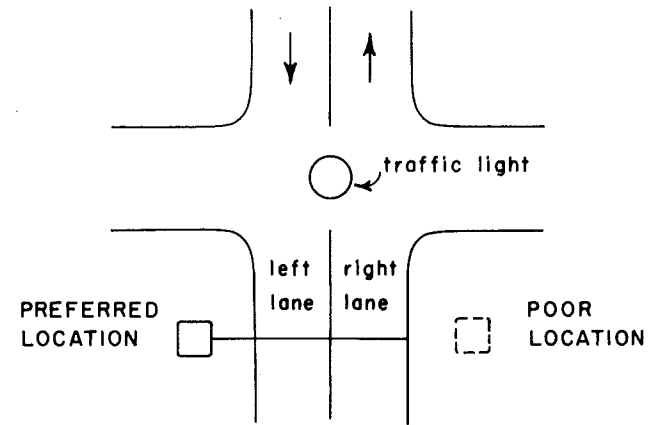


Fig. 21. Suggested Counter Location Near Traffic Signal With Two-Lane, Two-Way Operation.

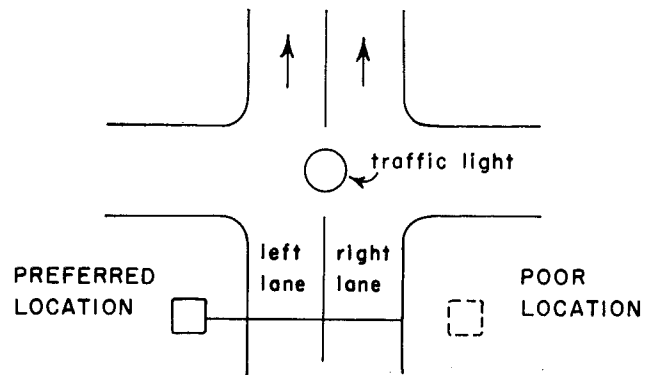


Fig. 20. Suggested Counter Location Near Traffic Signal With Two-Lane, One-Way Operation.



Fig. 22. Twice-a-day service is essential. A service check is an inspection of the counter mechanism to determine that the correct time and count are being recorded.

SUMMARY

1. *Direct Benefits of Traffic Counts:* This manual is dedicated to the proposition that every county highway department should have a continuing program of traffic counts. With minor expenditures for traffic count equipment and personnel, county road planning can proceed on a factual basis. The advantages and benefits of a traffic count program are many; here are a few that have special meaning and importance to county road officials.

(a) *Road Improvement Priorities:* The allocation of funds for road improvements involve difficult and vexing decisions for county road officials, mainly because the needs and demands for improvement always exceed available funds. Traffic count programs provide county road officials with a basic scale of comparison to establish priorities and schedules for road improvement projects. In this way, available funds can be budgeted to provide improvements that will serve the greatest number of people. However, traffic counts are not the sole basis for deciding the order of improvement; accident records and continuity of road improvements along a particular route are also important factors in deciding which projects get built first, second, third, etc.

(b) *Design of Road Improvements:* Traffic counts have always been a basic consideration of road design. Standards for the depth of base, pavement thickness, pavement width and safety features are all based on the type and amount of traffic that is expected to use the road. The object of any road improvement is to *reduce maintenance* and improve safety by the most *economical design*. This can only be accomplished with up-to-date traffic count data to eliminate the "guess-work" in the project design standards.

(c) *Change in Travel Patterns:* The pattern of travel on county road systems is in a constant state of change and increase. A growing and shifting population, industrial expansion, increased suburban living, new shopping centers, new schools, new recreation centers are all factors producing change in the pattern of travel on county roads. This is readily apparent to even the casual observer; yet to follow this change and measure needs in a realistic way, means that the counties must maintain a continuing program of traffic counts. After a few years experience, the patterns and trends of traffic on the county system will provide a basis for "estimating" traffic growth. This will be especially important on the county arterial road system.

2. *Organizing a Traffic Count Program:* There is no standard plan or procedure for organizing a traffic count program. It will require

of course, a certain minimum amount of equipment and personnel to get started. Populous counties with sizable cities and metropolitan centers will of necessity mount a somewhat different program than a predominantly rural county, even though the principles involved are much the same. Here are a few guidelines that will be of assistance to the county undertaking traffic counts for the first time.

(a) *Equipment and Personnel:* Most counties can make effective use of at least four (4), 15-Minute Counters. This is sufficient to count all four (4) legs of an intersection at the same time and is commonly needed to analyze the warrants for STOP signs. Four counters should be the minimum number considered for a rural county with a county seat town of 10,000 or more. The urbanized, metropolitan county will of course have greater needs for equipment. Smaller and less populous counties may want to consider a counter-sharing plan with a neighboring county.

A full-time traffic technician plus a helper should be assigned to the traffic count detail. The traffic technician should be allowed to gain the complete range of experience in the maintenance and operation of the counters, as well as the layout of the traffic count program itself. The duties of the traffic technician and helper should also include other traffic-related functions, such as maintenance of traffic control signs, county road accident records and school safety programs.

(b) *Use of ISHC Traffic Data:* The initial effort in starting a county traffic count program should include a complete review of traffic count information available from the Indiana State Highway Commission. The traffic statistics on the state highway system are being updated constantly. Counties should therefore make use of the most current information available, especially the counts on the county federal-aid system and the expansion factors from the ISHC continuous count stations.

(c) *Getting Started:* "Which roads get counted first?" is a logical question. As with other phases of county road planning, the major emphasis initially should be on the county arterial road system, on high-volume suburban roads not on the arterial system and on all other roads serving major traffic generators, such as schools, factories, shopping centers, etc.

"Should traffic counts be taken on all roads in the county system?" is another logical question. This is mostly a matter of local preference. Generally, low-volume roads below 50 cars per day will not occupy a very high position on a priority list for improvement. How-

ever, it may be desirable for the sake of completeness or other reasons to have a traffic count for each and every road in the county system.

(d) *Annual Count Programs:* Once underway, county-wide traffic counts should be repeated periodically. Counts should be repeated annually in fast-growing communities and in populous, metropolitan counties. Counts may be repeated less frequently in predominantly rural counties, say every three years. Regardless of the county-wide repeat cycle used, roads serving new traffic generators (new schools, new factories, etc.) should be counted annually until a consistent traffic pattern has been established.

County road officials should refer to HERPIC Bulletin No. 9, "*Annual Travel on County Highways of Indiana*," when planning county-wide traffic surveys of the total county road system. This publication has some useful guidelines on the organization of such a program, using a combination of both machine counts and manual counts.

(e) *Compiling Data and Records:* The most convenient form of presenting county-wide traffic counts is in the form of a county road map with the traffic volumes indicated at each count station. Such a traffic map will serve as a planning tool for county road officials and as a public relations instrument to explain the program of annual road improvements to the public.

A special effort should be made to maintain accurate and complete records on all traffic count data, worksheets and calculations. Such items as dates, location of stations, weather conditions should be recorded with each day's count. All pertinent information needed to verify results should be maintained in the county highway files.

3. *Traffic Growth Factors:* County highways and bridges should be planned and designed to accommodate future traffic. For this reason a factor must be applied to current traffic counts to provide for the anticipated traffic growth during the life of the completed project (normally considered as 20 years). Traffic counts on county roads for a period of say 5 to 10 years will serve as a basis for estimating future traffic growth. However, because most counties do not have an active traffic count program, it will be necessary to use the ISHC traffic growth factors based on current trends in vehicle registrations and fuel consumption.

Current forecasts by the ISHC for an average county-wide traffic growth factor (for the 20-year period ahead) varies from about 1.6

to 2.3. As with the traffic count statistics, these forecasts are being constantly updated. County road officials are therefore urged to consult the ISHC for the latest growth factor applicable to their particular county road system.

BIBLIOGRAPHY

1. Vodraska, Walter C. and Michael, Harold L. *Annual Travel on County Highways of Indiana*, County Highway Series—No. 9, Purdue University—Engineering Experiment Station, Lafayette, Ind., March 1967.
2. Michael, Harold L. *Characteristics of Travel on Indiana Highways*, Proceedings of the 40th Annual Purdue Road School, Extension Series No. 86, Vol. 38, No. 4, pp. 188-230, July 1954. (Engineering Reprint of the Joint Highway Research Project No. 101.)
3. Streeter Amet, "Trafficcounter Installation & Operating Instructions," Instructions 0-1200T, Grayslake, Illinois.
4. Streeter Amet, "Roadtube Installation Instructions," Instructions 0-1100, Grayslake, Illinois.

APPENDIX A

1969-1970 ANNUAL AVERAGE 24-HOUR TRAFFIC COUNTS
For 28 Permanent Traffic Counting Stations Maintained by the
Indiana State Highway Commission

Station No.	Automatic Traffic Recorder Location	Annual Average 24-Hour Traffic Counts	
Permanent Traffic Recorders Located on Main Highways in Rural Areas			
		(1969)	(1970)
100-K (14-A)	On US 41 south of Cook	11,615	10,134
25-A	On SR 9 south of Rome City	3,103	3,245
42-A	On US 52 at the Jct. with SR 28	13,715	14,228
47-A	On SR 1 south of Farmland	1,003	1,064
59-A	On US 40 east of Greenfield	3,683	3,667
68-A	On US 50 west of Aurora	5,813	5,703
72-A	On US 31 south of Seymour	2,583	2,696
74-A	On SR 54 east of Jct. with US 41	2,405	2,459
134-A	On US 30 northwest of Fort Wayne	10,010	10,302
172-A	On I-65 south of Seymour	12,276	13,271
173-A	On US 41 north of Vincennes	8,277	8,960
200-X	On US 31 8 mi. north of Columbus	19,636	20,416
254-A	On US 31 north of Argos	6,346	6,814
256-A	On US 421 south of Medaryville	2,750	2,618
262-A	On US 24 East of Wolcott	2,414	2,571
279-A	On US 6 east of Nappanee	4,599	4,764
281-A	On SR 13 south of North Webster	3,432	3,645

APPENDIX A—Continued

1969-1970 ANNUAL AVERAGE 24-HOUR TRAFFIC COUNTS
For 28 Permanent Traffic Counting Stations Maintained by the
Indiana State Highway Commission

Station No.	Automatic Traffic Recorder Location	Annual Average 24-Hour Traffic Counts	
Permanent Traffic Recorders Located on Main Highways in Rural Areas			
		(1969)	(1970)
301-A	On US 421 north of Versailles	3,232	3,298
313-A	On SR 67 southwest of Jct. with SR 39	5,298	5,572
319-A	On SR 56 east of Haysville	1,569	1,566
3070-A	On I-70 east of Greenfield	11,478	12,999
5420-A	On US 136 west of Crawfordsville	1,638	1,722
5474-A	On I-74 under SR 55 bridge	5,042	5,390
Average		5,927	6,396
Traffic Recorders Located on Main Highways in Urban and Suburban Areas			
40-A	On SR 25 south of Lafayette	5,369	5,921
45-B	On SR 67 south of Muncie	6,927	7,107
Average		6,158	6,514
Traffic Recorders Located on Local Roads			
34-A	On county road in Allen County	1,053	1,118
73-A	On old US 41 north of Vincennes	1,688	1,749
7047-A	On county road in Rush County	263	274
Average		1,001	1,047

APPENDIX B

Factors to Expand 24-Hour Weekday (Mon., Tues., Wed., Thur.)
 Volumes to A.D.T. 1970-1969-1968-1967

Groups	Months of Year											
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Group I	State Roads in Most Rural Areas											
1970	1.332	1.262	1.159	1.148	1.063	0.950	0.912	0.920	1.026	1.073	1.109	1.111
1969	1.358	1.250	1.198	1.109	1.082	0.961	0.927	0.911	1.043	1.060	1.113	1.155
1968	1.297	1.266	1.212	1.108	1.078	0.978	0.925	0.914	1.040	1.075	1.124	1.176
1967	1.320	1.320	1.218	1.130	1.088	0.973	0.930	0.927	1.051	1.097	1.154	1.153
Group II	State Roads in Rural Resort Areas											
1970	1.485	1.499	1.398	1.246	1.115	0.938	0.875	0.897	1.126	1.234	1.291	1.257
1969	1.477	1.439	1.374	1.226	1.127	0.944	0.873	0.870	1.199	1.236	1.393	1.335
1968	1.462	1.444	1.373	1.212	1.125	0.949	0.845	0.864	1.127	1.212	1.298	1.345
1967	1.514	1.558	1.377	1.222	1.166	0.939	0.870	0.885	1.161	1.245	1.356	1.313
Group III	State Roads in Mining Areas											
1970	1.320	1.209	1.126	1.043	1.002	0.965	0.942	0.912	0.988	1.000	1.036	1.029
1969	1.161	1.059	1.088	1.000	0.992	0.957	0.940	0.931	0.982	1.031	1.094	1.079
1968	1.187	1.110	1.063	0.997	0.956	0.959	0.925	0.968	0.977	0.988	1.053	1.057
1967	1.119	1.123	1.033	0.986	0.973	0.963	0.964	0.956	0.942	0.991	1.079	1.058
Group IV	State Roads in Suburban Areas											
1970	1.208	1.144	1.031	1.067	0.988	0.950	0.942	0.928	0.919	0.943	0.970	0.985
1969	1.239	1.141	1.071	1.025	0.954	0.949	0.931	0.925	0.967	0.984	1.007	1.028
1968	1.204	1.148	1.109	1.061	1.017	0.988	0.989	0.983	1.015	1.008	1.008	1.030
1967	1.135	1.172	1.043	1.010	1.059	0.960	0.959	0.966	1.017	1.059	1.093	1.056
Group V	Local Roads in Rural Areas											
1970	1.199	1.112	1.074	0.971	0.973	0.900	0.928	0.936	0.943	0.999	0.965	1.017
1969	1.198	1.101	1.070	1.001	0.962	0.901	0.921	0.960	0.965	0.957	1.006	1.008
1968	1.206	1.091	1.064	0.990	0.979	0.896	0.932	0.929	1.003	0.965	0.981	1.087
1967	1.160	1.146	1.068	1.015	0.957	0.863	0.901	0.958	1.076	1.018	1.001	1.045

65

51

APPENDIX C

Route SR #446

Station #23

Indiana Automatic Traffic Recorder Record
 Prepared by State-Wide Highway Planning Survey
 Traffic Survey of Monroe Reservoir Area

Week Beginning 8-23-70

R.C. No. 72

Day	Sun.	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Total
Date	8-23	8-24	8-25	8-26	8-27	8-28	8-29	
Weather	Nor.	Nor.	Nor.	Nor.	Nor.	Nor.	Nor.	
Hour	A.M.							
12-1	45	14	16	15	20	25	60	
1-2	45	2	16	22	17	16	44	
2-3	21	5	2	6	2	6	17	
3-4	6	3	2	5	8	5	15	
4-5	8	4	6	3	7	7	23	
5-6	20	14	17	15	23	17	28	
6-7	37	61	72	70	71	60	80	
7-8	47	104	122	121	102	100	102	
8-9	65	93	61	63	64	62	80	
9-10	123	76	53	71	69	59	125	
10-11	206	96	88	75	98	97	168	
11-12	261	117	114	120	99	114	210	
	P.M.							
12-1	313	117	129	98	115	137	199	
1-2	308	112	147	113	124	120	224	
2-3	341	126	145	147	138	149	226	
3-4	398	140	153	160	130	161	234	
4-5	387	196	199	193	186	181	240	
5-6	396	162	175	171	164	169	235	
6-7	342	148	169	147	132	204	233	
7-8	275	117	118	131	134	201	208	
8-9	289	107	181	162	143	201	211	
9-10	215	131	157	157	156	190	204	
10-11	67	59	66	46	64	115	137	
11-12	31	43	40	40	32	69	77	
Total	4246	2047	2248	2151	2098	2465	3380	

% Aver.
 Wk. Day

Remarks—Located on SR #446 0.20 mile northwest of Swartz Road
 Counter Chained to: Road sign on south side of the road

Average Weekday

APPENDIX D

Sample Manual Count Form For an 8-Hour Coverage Station Count
 County Highway Traffic Study

County ----- Date ----- Name -----
 Counting Location -----

VEHICLE CLASSIFICATION

Time	Passenger Cars	Pickup and Panel Trucks	Other Trucks	Other Vehicles
AM 8:00- 9:00				
9:00-10:00				
10:00-11:00				
11:00-12:00				
LUNCH		12:00 noon to 2:00 p.m.		
PM 2:00- 3:00				
3:00- 4:00				
4:00- 5:00				
5:00- 6:00				

APPENDIX E

Indiana State Highway Commission
Summary of Permanent Traffic Recorder Data
Month of January 1968

Station 7047-A Location on E. and W. County Road From Carthage to Mays.
Counter Located 1.4 Miles E. of CCC and St. L. RR in Carthage in Rush County.

Day	Monday					Tuesday					
	Date	1	8	15	22	29	2	9	16	23	30
Weather	Snow	Snow	Snow	Cldy	Rain	Cldy	Snow	Fair	Snow	Rain	
A.M.											
12- 1	4	1	1	2	1	2	0	1	0	0	
1- 2	6	1	0	1	1	0	1	0	0	0	
2- 3	4	0	1	1	0	2	0	0	0	0	
3- 4	0	0	0	0	0	0	0	0	0	1	
4- 5	3	1	0	0	0	2	0	0	0	0	
5- 6	0	1	2	3	3	2	6	3	1	2	
6- 7	4	3	7	9	7	14	10	9	7	8	
7- 8	4	9	9	13	10	12	8	10	8	12	
8- 9	6	10	10	12	7	23	11	10	9	10	
9-10	8	13	12	16	12	23	15	11	12	16	
10-11	11	16	15	11	13	19	13	12	10	13	
11-12	14	17	19	13	16	31	15	12	10	13	
P.M.											
12- 1	8	15	11	13	13	25	13	14	11	13	
1- 2	6	16	12	15	13	20	14	14	12	14	
2- 3	4	18	14	19	16	22	15	11	18	32	
3- 4	16	19	15	19	17	22	25	16	17	34	
4- 5	18	30	18	21	19	29	14	17	19	19	
5- 6	7	16	13	15	17	11	13	16	16	24	
6- 7	13	12	10	14	13	16	14	10	12	20	
7- 8	5	9	9	8	8	8	5	5	9	6	
8- 9	7	5	4	8	6	9	8	8	6	5	
9-10	14	7	2	5	2	8	4	3	3	4	
10-11	12	4	4	2	3	6	5	4	2	4	
11-12	2	4	1	2	2	0	5	2	1	3	
Totals	176	227	189	222	199	306	214	188	182	253	
Pct. of No. Tot.	2.46	3.17	2.64	3.10	2.78	4.27	2.99	2.62	2.54	3.53	
	Average = 202					Average = 228					
	Four Day Average = 227										

APPENDIX E

Indiana State Highway Commission
Summary of Permanent Traffic Recorder Data
Month of January 1968

Station 7047-A Location on E. and W. County Road From Carthage to Mays.
Counter Located 1.4 Miles E. of CCC and St. L. RR in Carthage in Rush County.

Day	Wednesday					Thursday				
	Date	3	10	17	24	31	4	11	18	25
Weather	Cldy	Cldy	Fair	Fair	Rain	Fair	Cldy	Fair	Fair	
A.M.										
12- 1	0	1	0	0	1	2	3	1	1	
1- 2	1	2	1	1	0	1	1	1	4	
2- 3	0	0	0	0	0	1	0	0	0	
3- 4	0	0	0	0	0	0	0	0	1	
4- 5	2	2	0	0	0	2	1	1	1	
5- 6	5	3	4	2	1	3	3	3	1	
6- 7	8	10	9	8	6	6	5	11	7	
7- 8	11	12	11	10	10	13	10	13	11	
8- 9	12	18	11	10	12	15	15	13	11	
9-10	12	14	12	15	13	13	13	14	11	
10-11	16	18	13	10	15	23	17	15	16	
11-12	14	23	14	13	17	20	14	18	18	
12- 1	18	16	13	14	11	17	17	14	20	
P.M.										
1- 2	15	14	19	14	12	23	17	16	17	
2- 3	16	20	15	21	24	23	23	15	23	
3- 4	14	18	20	18	25	15	24	23	22	
4- 5	16	18	16	22	24	27	24	22	23	
5- 6	15	15	18	20	18	13	26	14	20	
6- 7	14	12	14	14	13	18	15	13	16	
7- 8	8	8	7	13	11	8	9	7	15	
8- 9	5	7	6	8	10	3	8	7	8	
9-10	5	6	4	5	7	5	20	4	7	
10-11	3	5	4	4	3	8	6	5	5	
11-12	3	4	3	3	4	4	2	1	2	
Totals	213	246	214	225	237	263	273	231	260	
Pct. of No. Tot.	2.97	3.43	2.99	3.14	3.31	3.67	3.81	3.22	3.63	
	Average = 227					Average = 256				
	Average Weekday = 235									

APPENDIX E

Indiana State Highway Commission
 Summary of Permanent Traffic Recorder Data
 Month of January 1968

Station 7047-A Location on E. and W. County Road From Carthage
 to Mays. Counter Located 1.4 Miles E. of CCC and St. L. RR
 in Carthage in Rush County.

Day	Friday				Saturday				
	Date	5	12	19	26	6	13	20	27
Weather	Fair	Cldy	Fair	Fair	Snow	Snow	Cldy	Cldy	
A.M.									
12- 1	1	2	2	2	1	2	3	1	
1- 2	2	1	2	3	1	0	2	0	
2- 3	0	0	0	0	2	0	1	1	
3- 4	1	2	1	4	0	1	0	4	
4- 5	2	2	1	1	0	0	0	0	
5- 6	3	2	1	0	1	1	0	0	
6- 7	7	8	8	5	8	0	6	1	
7- 8	12	13	9	9	9	0	5	6	
8- 9	14	18	14	10	17	3	7	9	
9-10	17	17	16	18	21	12	19	23	
10-11	15	19	13	21	19	16	24	25	
11-12	21	20	13	17	23	25	28	20	
P.M.									
12- 1	21	18	13	13	26	32	26	21	
1- 2	17	13	14	21	12	19	18	25	
2- 3	20	18	25	16	17	14	18	21	
3- 4	18	18	22	22	15	18	17	20	
4- 5	31	22	29	18	17	17	16	17	
5- 6	20	23	19	23	20	15	19	24	
6- 7	18	13	22	20	11	13	14	20	
7- 8	11	13	11	15	6	19	10	14	
8- 9	9	9	7	13	7	8	7	8	
9-10	6	14	10	8	6	29	4	4	
10-11	12	7	5	10	4	12	7	10	
11-12	5	7	3	6	6	7	3	7	
Totals	283	279	260	275	249	263	254	281	
Pct. of Mo. Total	3.95	3.89	3.63	3.84	3.47	3.67	3.54	3.92	
	Average = 274				Average = 261				
	Number of Weekdays			Number of Saturdays		Number of Sundays			
	23			4		4			
REMARKS									

APPENDIX E

Indiana State Highway Commission
 Summary of Permanent Traffic Recorder Data
 Month of January 1968

Station 7047-A Location on E. and W. County Road From Carthage
 to Mays. Counter Located 1.4 Miles E. of CCC and St. L. RR
 in Carthage in Rush County.

Day	Sunday				Average Hourly				
	Date	7	14	21	28	Wkday.	Sat.	Sun.	Total
Weather	Snow	Snow	Cldy	Rain					
A.M.									
12- 1	1	1	11	2	1	1	3	1	
1- 2	1	1	0	4	1	0	1	1	
2- 3	0	0	0	2	0	1	0	0	
3- 4	2	1	0	1	0	1	1	0	
4- 5	2	0	2	0	0	0	1	0	
5- 6	1	1	0	0	2	0	0	1	
6- 7	6	5	5	0	7	3	4	6	
7- 8	7	6	4	1	10	5	4	8	
8- 9	6	6	4	2	12	9	4	10	
9-10	10	12	10	13	14	18	11	14	
10-11	11	8	9	7	14	21	8	14	
11-12	12	11	18	20	16	24	15	17	
P.M.									
12- 1	14	12	10	13	14	26	12	15	
1- 2	13	11	12	10	15	18	11	15	
2- 3	10	13	15	10	18	17	12	17	
3- 4	13	14	13	16	19	17	14	18	
4- 5	19	15	18	33	21	16	21	20	
5- 6	19	14	16	19	17	19	17	17	
6- 7	10	13	12	10	14	14	11	14	
7- 8	8	12	10	10	9	12	10	9	
8- 9	7	4	4	5	7	7	5	6	
9-10	5	3	2	2	6	10	3	6	
10-11	3	4	3	2	5	8	3	5	
11-12	2	1	2	2	3	5	1	3	
Totals	182	168	180	184	235	261	178	231	
Pct. of Mo. Total	2.54	2.35	2.51	2.57					
					Average = 178				
Month	Act			Per Cent		Total			
January				Gain or Loss		Traffic			
67	242					7490			
68	230			-4.9		7176			

APPENDIX F

SUMMARY OF TROUBLE SHOOTING PROCEDURES

PROBLEM: The counter fails to record and print.

- SOLUTION:
1. Check the fuse and replace, if necessary.
 2. Check battery potential and polarity. The hydrometer should read approximately 1250 at 72°F.
 3. Check battery terminals to insure a good connection.

PROBLEM: The counter will record but fails to print.

- SOLUTION:
1. Check print start limit switch on clock to insure limit switch ON-OFF actuation.
 2. Check the print motor fuse.
 3. Check the print motor.

PROBLEM: The counter prints but fails to count.

- SOLUTION:
1. Check to insure proper diaphragm operation.
 2. Check battery polarity to insure battery + terminal is connected to chassis and battery-terminal is connected to the RC-terminal.
 3. Check to insure proper counter clapper actuation.
 4. If the count module is not working properly, replace.

PROBLEM: Continue to repeat printing during the print start command of the print clock switch.

- SOLUTION:
1. Check the print motor stop limit switch to insure ON-OFF actuation.
 2. Check the print lockout relay to insure it is energized by the actuation of the print motor stop limit switch.
 3. Check to insure the relay locks up through its own contacts to the print start switch.

PROBLEM: Duplicate printing will be caused by improper print cam dwell adjustment.

- SOLUTION:
1. Check to insure the cam dwell is approximately $\frac{1}{4}$ ".
 2. It may be necessary to loosen the screw on the motor stop cam and position it forward slightly to decrease the cam dwell.
 3. Check to insure that the typewheels are in reset position. It may be necessary to loosen the set screw on the print cam and position it in relation to the print hammer cam rider.

NOTE: An overrun of the print cams will cause a loss in print-out total.

EXAMPLE: A 10:00 a.m. print command may print out a normal print of 10: A 0481, an 11:00 a.m. print may show 11: A 0000 and the 12:00 a.m. print-out may be normal. This indicates that at 10:00 a.m., a normal print-out was obtained and during the recocking of the print hammer, the print cam rider overran, dropping the hammer in print position. On the 11:00 a.m. print command, the hammer was recocked and the print typewheel reset, failing to print-out the hourly total.

PROBLEM: Replace a defective counter coil.

- SOLUTION:
1. Unsolder the wires from the coil terminal.
 2. Loosen and remove the three nuts and screws securing the coil to the counter frame.
 3. Replace the coil in exact reverse of above procedure.
 4. Before tightening screw to secure coil, place a piece of paper between coil and clapper, then pull clapper down to the end of travel. Position coil to fit flat against clapper in such a way that the paper can be moved freely. Tighten the three nuts and screws to secure coil in position.

PROBLEM: The module is malfunctioning due to component failure.

SOLUTION: Replace module in counter.

PROBLEM: How to repair defective module.

- SOLUTION:
1. Refer to Drawing 0203163, 1 through 5 of 5.
 2. Using an oscilloscope, trace circuit, and locate defective component. Replace the defective component. Check module to insure it conforms with Drawing 0203163. (4 of 5).

**HERPIC PUBLICATIONS AVAILABLE ON REQUEST
ENGINEERING BULLETINS**

County Highway Series

- No. 1 *Dust Control on Unpaved Roads* (20 pages)
 No. 2 *Roadside Weed and Brush Control with Chemicals* (34 pages)
 No. 3 *County Subdivision Control: Model Ordinance with Discussion* (46 pages)
 No. 4 *Principles of Highway Drainage and Erosion Control* (65 pages)
 No. 5 *An Analysis of Traffic Accidents on County Roads* (26 pages)
 No. 6 *Planning and Financing County Bridge Programs* (66 pages)
 No. 7 *Minor Maintenance of County Bridges* (44 pages)
 No. 8 *County Bridge Painting* (49 pages)
 No. 9 *Annual Travel on County Highways of Indiana* (22 pages)
 No. 10 *Inventory of Indiana County Bridges* (27 pages)

**HERPIC REPORTS
Better County Roads**

- 1-61 *Mineral Aggregate Materials for County Road Construction* (4 pages)
 2-61 *Sizes and Gradings of Aggregates for Road Construction* (4 pages)
 3-61 *Bituminous Materials for County Road Construction* (4 pages)
 4-61 *Cumulative Bridge Funds for Construction and Repair of County Bridges* (4 pages)
 5-61 *Cumulative Bridge Funds—Questions and Answers on Establishment and Use* (4 pages)

ALSO

Handbook of Facts and Figures on Indiana County Roads—including Directory of Indiana County Highway Departments (Information piece—50 pages)

Write requests to:

HERPIC
 Civil Engineering Building
 Purdue University
 Lafayette, Indiana 47907

**THE SCHOOL OF ENGINEERING AT
PURDUE UNIVERSITY**

Graduate degrees are offered in the fields of aeronautical and engineering sciences, and agricultural, chemical, civil, electrical, industrial, mechanical, metallurgical, and nuclear engineering.

The research activities in these fields are conducted as a part of the program of graduate instruction with students participating under the direction of their professors. As the engineering profession faces increasing responsibilities for dealing with problems whose solutions lie at the frontiers of knowledge, the programs of graduate research and education in the engineering schools are increasingly concerned with the fundamentals of the physical sciences and mathematics.

H.H. **Location:** RL
Guidelines for Traffic Counts on County
Roads
County Highway Series - No. 12

INDIANA LTAP

A01890