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ABSTRACT

Part of the series "Managing Highway Maintenance," the unit describes the ways maintenance standards are developed and some of the factors which are considered in setting standards; the preceding unit on standards (part 1) should be completed before reading this unit. The format is a programed, self-instruction approach in which information is presented in progressive segments or frames. (EA)

MANAGING HIGHWAY MAINTENANCE

STANDARDS FOR MAINTENANCE WORK

PART TWO

Management by Objectives Series

UNIT 8

LEVEL 2

FEDERAL HIGHWAY ADMINISTRATION
Offices of Research and Development
January 1973

This book is part of the series "Managing Highway Maintenance," prepared for the Implementation Division, Office of Development, Federal Highway Administration, under contract FH-11-7600. The series as a whole is described in the *Training Guide and Catalog* volume.

The contents of this book reflect the views of the contractor, Roy Jorgensen Associates, Inc. The contents do not necessarily reflect the official views or policy of the Department of Transportation.

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Implementation Division
Offices of Research and
Development

Washington, D.C.
January 1973

PART TWO

HOW STANDARDS ARE DEVELOPED

INTRODUCTION

This is Part Two of "Standards for Maintenance Work." It describes the ways standards are developed and some of the things which are considered in setting standards. This part includes descriptions of a few typical maintenance standards -- and it should be read after you have completed Part One.

TRAINING TECHNIQUE

The information in this unit is presented in small segments -- called frames. Most frames require you to answer a question about the information in the frame. The answer you pick will instruct you to go to a different part of the unit. To complete the training:

+ CAREFULLY READ EACH FRAME.

+ FOLLOW THE DIRECTIONS AT END OF EACH FRAME.

Turn the page and read Frame 1.

Section One

DEVELOPING STANDARDS

Standards have been defined as models that should be followed or goals to be reached. They help you provide a consistent level of maintenance and they give definite direction to everyone who uses them.

1 (continued)

In developing maintenance standards, the head office keeps in mind three important qualities:

1. Standards must be the result of careful thinking.

2. Standards should be followed by field personnel.

3. Standards must be easily changed or replaced.

Which of these three qualities probably has the most to do with developing standards?

A. The first. Go to Frame 2.

B. The second. Go to Frame 3.

C. The third. Go to Frame 4.

2

Right. Standards are developed as a result of "careful thinking." That term is rather vague because there are many ways of developing good standards. How they are developed is not too important as long as the resulting standards are good. That is, so long as the standards have the important qualities listed in Frame 1.

A better description of "careful thinking" is still in order. Go to Frame 5.

3

No. Following standards is not too closely related to developing standards. There's a better choice available.

Go back to Frame 1 and choose again.

4

No. It's true that changing or replacing standards amounts to redeveloping standards, but there's another choice that answers the question even better.

Go to Frame 1 and make a better choice.

5

Standards are carefully thought out when the following details are considered:

1. Safety of the motoring public and highway maintenance personnel.

2. Preservation of the roadway facilities.

3. General appearance of the roadway and surrounding area.

4. The degree to which the standards can be applied throughout the Department.

5. Public opinion.

In general, these details are listed in the order of their importance. But public opinion might not be the least important. General appearance, for example, is very dependent on public opinion.

5 (continued)

Any system of developing standards which takes these five factors into consideration is usually good.

Is the method of developing standards very important?

A. Yes, very important. Go to Frame 6.

B. No, the results are more important than the method used to get them. Go to Frame 7.

6

Perhaps. The method must consider these five factors. Otherwise the standards may not be very good. In this sense the method is very important.

But as long as the five factors are considered, almost any method of developing standards will do. In this sense the particular method used is not of too much importance.

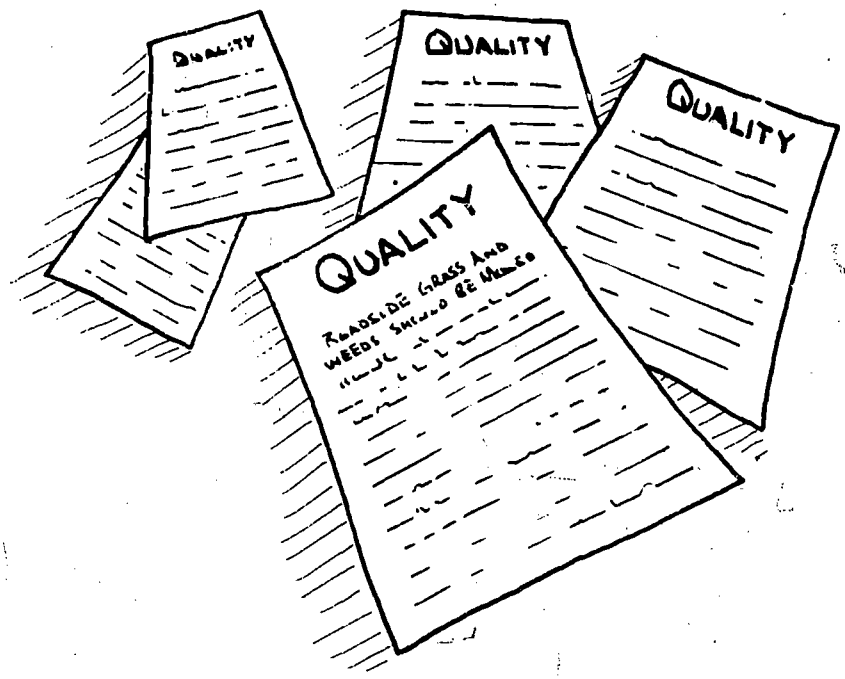
Go to Frame 8.

7

In a sense, you're right. As long as these five factors are used, almost any method of developing standards is O.K.

But the five factors must be given enough consideration. In this sense, the method is very important; it must be based on enough considerations.

Go to Frame 8.



8

DEVELOPING QUALITY STANDARDS

Standards usually are established by a head office committee. A good starting point for this committee is quality standards, since they answer the question, "How bad should a condition be before it should be repaired?" The standards committee tries to answer that question as definitely as is practical. In general, a standard that expresses an amount is definite. Unfortunately, it's not always practical for an amount to be stated in a quality standard, but it's the ideal.

8 (continued)

Suppose the quality standard for mowing were: "Cut down the grass and weeds to a reasonable height whenever it gets too high." This standard does not express an amount. It doesn't say what is "a reasonable height" or how high is "too high."

Why should quality standards be quantitative -- or express an amount?

A.	Because it's easier to make standards that way.	Go to Frame 9.
B.	Because it's easier to follow standards that way.	Go to Frame 10.
C.	They shouldn't be quantitative.	Go to Frame 11.

9

No, it isn't. It's much easier to advise cutting the grass to "a reasonable height" whenever it's "too high" than to go through the research and calculation necessary for a definite standard that expresses a particular amount. Any citizen on the road could say, "When the grass gets too high, cut it down to a reasonable height." No special difficulty is involved in that answer.

Go back to Frame 8 and try again.

10

Right. It's much easier to follow standards which describe conditions using numbers. "When the vegetation is 14 inches high, cut it down to a height of five inches." This standard is easy to follow because it is quantitative; it uses numbers. If two foremen disagree on whether or not to mow the vegetation, all they need is a yardstick or a rule to measure the height of the grass and weeds. But if the standard does not use numbers, the two foremen can argue forever and still not agree on the meaning of "too high" or "a reasonable height."

Like everything else, numbers in quality standards have their limits. Some quality standards can't be both quantitative and practical.

Which of the following quality standards is best for litter pickup?

A. Pick up litter to the extent necessary to preserve a neat and uncluttered appearance. Go to Frame 12.

B. Pick up litter when there are two or more pieces of litter in an (average) square yard, or when litter occupies an average of 16 square inches in a square yard. Go to Frame 13.

C. Schedule litter pickup on the right-of-way every time 200,000 vehicles have been estimated to have passed. Go to Frame 14.

11

Yes, they should, when practical. Quantitative quality standards leave little to the imagination, and that's good when it refers to guidelines.

Go to Frame 8 and choose a better answer.

12

This is probably the best choice. It leaves a lot of room for interpretation, but it is certainly better than the other two choices which are much too complicated. Whenever practical, standards should be quantitative, but they shouldn't be ridiculous.

Should there be quality standards for every maintenance activity? Ideally, yes. But some operations are so minor that standardizing them isn't worth the effort.

Suppose that a shipment of corrugated metal pipes came to the garage by truck. John and his crew spent a full day stockpiling them in the yard. Would this activity have a quality standard?

A. Yes. Go to Frame 15.

B. No. Go to Frame 16.

13

Probably not. This standard is certain to cause trouble. Some people would say it's too hard because, "who knows how to measure the area of a beer can?" Others would say it's too complicated and takes too long to apply the test; a visual judgment is easier. In any case, it is probably safe to say that no one would apply the standard for long.

Go back to Frame 10 and make another choice.

14

No. This standard is probably too mathematical. It also does not take into account the different characteristics of different roads. One segment of a road may be relatively clean. Another segment may have drive-in restaurants on both sides of the road and be the principal route used by garbage trucks on their way to the incinerator. One segment is clean, the other is cluttered. Yet, if the traffic is about the same, the litter service is similar.

There's a better choice available. Go to Frame 10 and make another choice.

15

Maybe. The situation seems simple, but in some departments it may occur quite often. If this is the case, there probably is an operation called "stockpiling" which has very general standards.

In other departments stockpiling material might not take place often enough for a standard to be useful.

Ideally every maintenance activity should be standardized, but in practice it's not always possible or practical.

And every quality standard should be as definite as possible and still be practical.

Go to Frame 17.

Perhaps. If stockpiling material is not done very often, there's probably little use for standards. They won't be remembered or they won't apply by the time a new shipment arrives. Or maybe storage facilities are very limited. In this case, stockpiling may challenge any supervisor's imagination. Here, too, there would be little practical use for standards.

However, if stockpiling is a common activity, and if it is done by a crew, standards are in order.

Every maintenance activity ideally should be standardized, but in practice it's not always possible or practical.

And every quality standard should be as definite as possible and still be practical.

Go to Frame 17.

17

DEVELOPING QUANTITY STANDARDS

Quantity standards answer the question "How much work has to be done, and how often, in order to satisfy the quality standard?" So, a quantity standard is usually expressed as an estimate of the amount of work to be done on one unit of measurable roadway feature -- in a specific period of time. The table on the next page shows example quantity standards for premix patching, ice control and mowing.

17 (continued)

ACTIVITY	WORK ESTIMATE	ROADWAY FEATURE	PERIOD
Premix Patching	$\frac{1}{4}$ ton of premix	Per lane-mile	Per year
Ice Control	1,000 lbs. of salt	Per lane-mile	Per winter
Mowing	4 acres	Per mowable acre	Per season

The standard for Premix Patching says that about $\frac{1}{4}$ ton of premix should be used for every lane-mile of roadway in one year. The Mowing standard states how often mowing should be done -- each acre should be mowed four times during the mowing season.

So, a quantity standard states how much or how often work has to be done.

Which of the following statements contains enough information to be a quantity standard?

A. In crack filling operations the Department uses 12,000 gallons of sealant per year. Go to Frame 18.

B. In seal-coat operations the Department seals 1/5 of a lane-mile for every lane-mile each year. Go to Frame 19.

C. The Department's shoulder patching activities use $\frac{1}{2}$ cubic yard of gravel per shoulder-mile. Go to Frame 20.

D. The Department's ditch reshaping activity is measured in ditch-miles per year. Go to Frame 21.

18

No. This statement doesn't give enough information. You know the quantity or work estimate -- 12,000 gallons of sealant. And you know the time period -- per year. But what about the unit of measurable roadway feature?

Quantity standards must give the work estimate per unit of roadway feature per time period.

Go to Frame 17 and make another choice.

19

Right. All three factors are contained in this statement: the work estimate, the raodway feature and the time period.

Quantity standards are developed in a variety of ways ranging from the most detailed to the most casual. But any good method includes consideration of the five factors mentioned in Frame 5 (safety, preservation, appearance, how the standards can be applied and public opinion). A good method also includes a study of past practices and of present theories on what the practices should be.

What can we conclude?

A.	Any method can be used to develop quantity standards.	Go to Frame 22.
B.	There is only one basic method of developing good quantity standards.	Go to Frame 23.
C.	There are many ways of developing good quantity standards, but they all have the same basic considerations.	Go to Frame 24.

20

No. This statement doesn't show how often the Department uses $\frac{1}{2}$ cubic yard per shoulder-mile. Is it every month? Every year? It makes a difference, so we should know. Usually this time period is a season or a year, since the Department plans a year at a time.

Quantity standards should give the work estimate per unit of roadway feature per time period.

Go to Frame 17 and choose a better answer.

21

No, this statement cannot be a quantity standard because it doesn't mention any quantity, any number.

Quantity standards must give an estimate of the work to be done in units of work per unit of roadway feature per time period.

Go to Frame 17 and choose again.

22

Perhaps. But any method used to develop standards should give consideration to the basic factors listed in Frame 5. So there are many good methods of developing standards, but they all use the same basis.

There's a better answer offered. Go to Frame 19 and choose it.

23

This is not true. Many departments have developed quantity standards, but not many have used exactly the same method. They had to have the same basic goal and use the same considerations listed in Frame 5 -- but they probably didn't use the same method.

Go back to Frame 19 and choose again.

24

Right. There are many ways of developing standards, but they all are based on the same considerations.

When a maintenance activity uses material its usually fairly easy to develop quantity standards. Purchase orders show how much material has been used in the past, and the head office standards panel determines if that amount satisfies the quality standard. Past materials quantities are good -- but only if the level of maintenance in the past was acceptable.

Suppose that five years ago the Department maintained 1,000 lane-miles of bituminous paved roads and used 250 tons of premix for patching.

$$\frac{250 \text{ tons of premix}}{1{,}000 \text{ lane-miles}} = .25 \text{ or } \tfrac{1}{4} \text{ ton of premix/lane mile}$$

Last year the Department maintained 1,200 lane-miles and records show that it used 300 tons for patching.

$$\frac{300 \text{ tons of premix}}{1{,}200 \text{ lane-miles}} = .25 \text{ or } \tfrac{1}{4} \text{ ton of premix/lane-mile}$$

24 (continued)

Will the Department set the quantity standard as $\frac{1}{4}$ ton of premix per lane-mile per year?

A.	Most probably.	Go to Frame 25.
B.	Who knows?	Go to Frame 26.
C.	Definitely not.	Go to Frame 27.

25

Right. If the quantity used in the past satisfied the quality standard and if the past level of maintenance was acceptable, chances are good that the same quantity will be adequate for the near future.

When an activity does not use materials, other methods are used. For instance mowing, litter pickup and gravel shoulder reshaping are operations which need no material. Purchase records can't be used because there aren't any. In these cases, an estimate is made of how often the activity should be done. This estimate, again, is made after discussions with field personnel and after checking past records.

No matter what the operation, its quantity standards are developed by:

A.	Sound engineering judgment.	Go to Frame 28.
B.	A combination of sound judgment and accurate research.	Go to Frame 29.
C.	Thorough research.	Go to Frame 30.

26

Nobody knows with certainty what the Department will do, but there is a very likely course it will follow. The past five years are rather consistent.

Go back to Frame 24 and choose another answer.

27

This is definitely not a good answer. The past five years seem to show that the Department used $\frac{1}{4}$ ton per lane-mile each year. Has something drastic happened to change that average in the future? Has the Department been unhappy with the premix patching operation for the last five years?

There's a better answer to the question in Frame 24. Go there and find it.

28

Usually more than sound engineering judgment is used to develop quantity standards. Past practices are studied and present ideas understood before good quantity standards are developed.

Go to Frame 25 and choose a better answer.

29

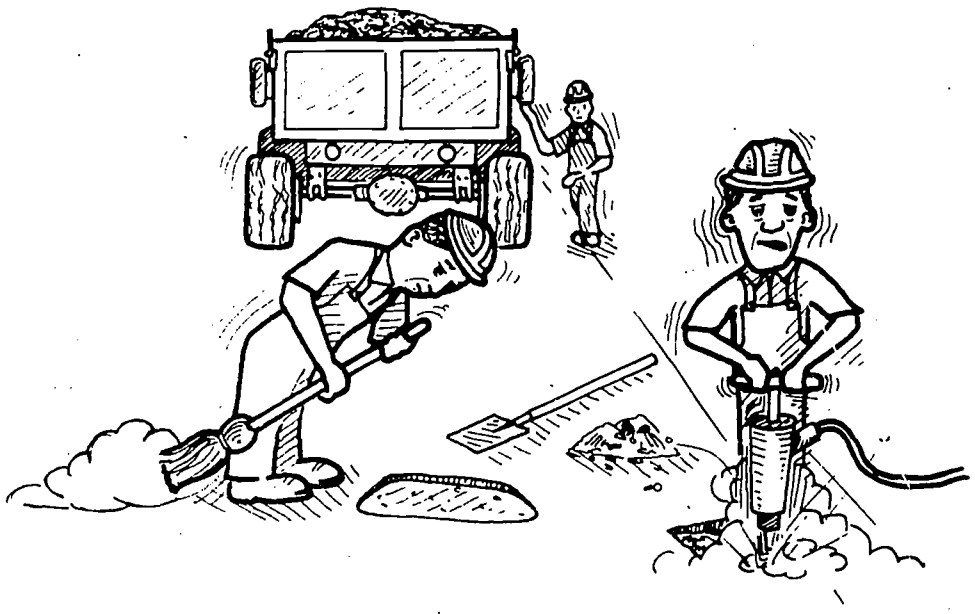
Right. Both are used to develop good quantity standards.

Go to the next section, Frame 31.

30

Thorough research is thorough book knowledge. It's incomplete for maintenance purposes. Practical knowledge of actual conditions is also needed.

Go back to Frame 25 and choose a better answer.



31

DEVELOPING PERFORMANCE STANDARDS

Performance standards are the standards most used by field personnel. They show how many men should do an activity, what equipment should be used, how the operation should be performed, what materials should be used and how much work should be done in one day.

31 (continued)

Like the other standards, performance standards are developed in many ways. What is most important is that consideration is given to the five basic factors mentioned earlier (safety, preservation, appearance, how the standards can be applied and public opinion) and that some study is made to find the best performance standard for the activity.

How is a performance standard most like a quality and a quantity standard?

A.	A performance standard contains some of the same kinds of information as both quality and quantity standards.	Go to Frame 32.
B.	A performance standard is made up of both a quality and a quantity standard.	Go to Frame 33.
C.	All three kinds of standards are based on five basic factors.	Go to Frame 34.

32

No. Each type of standard contains different information:

A quality standard states how bad a condition must be before it is repaired.

A quantity standard shows the work estimate per unit of measurable roadway feature per time period.

A performance standard shows:

+ how many men should do an activity,
+ what equipment should be used,
+ how the operation should be performed,
+ what materials should be used, and
+ how much work should be done in one day.

Choose another answer from Frame 31.

33

No. Each type of standard contains different information and stands alone as goals to be reached.

There is a way in which they are alike. Find the correct answer in Frame 31.

34

Right. All three kinds of standards are based on five basic factors: safety, preservation, appearance, how they can be applied and public opinion.

Like quantity and quality standards, performance standards are also developed in many ways. Each agency develops these standards in the way that seems best to all concerned. The important thing about developing standards is that they are developed, not so much how they are developed.

Go to Frame 35.

35

Realistic, well thought-out, easily understood standards are the goal of any head office standards panel. But the panel also tries to develop standards in a reasonable time. Standards five years late aren't much better than no standards at all. The panel knows that the sooner there are standards -- and they don't have to be perfect -- the sooner work can be done better, and the sooner maintenance costs can be controlled.

35 (continued)

When we say that it's better to develop imperfect standards quickly than to develop near-perfect ones very slowly, we are assuming:

A. That standards can be readily changed. Go to Frame 36.

B. That speed is more important than quality. Go to Frame 37.

C. That conditions change slowly. Go to Frame 38.

36

Right. If standards are hard to change, it's better to get them right the first time. But when standards are easy to change, imperfect ones are changed as their defects become known. In this way the imperfect standards become very good standards after a period of time.

In summary, there are many methods for developing standards. But the method is not too important. Quality and speed are more important factors, and speed usually brings about good quality -- sooner or later.

Quality standards should be as definite as possible. Quantity standards should reflect the quality standards. And performance standards should be realistic and easy to understand.

Go to the next section -- Frame 39.

37

Not exactly. Speed is more important than quality only when it leads to a good "speed-quality" combination. Otherwise the two factors are of equal importance.

A good speed-quality combination is one which doesn't cost the Department too much.

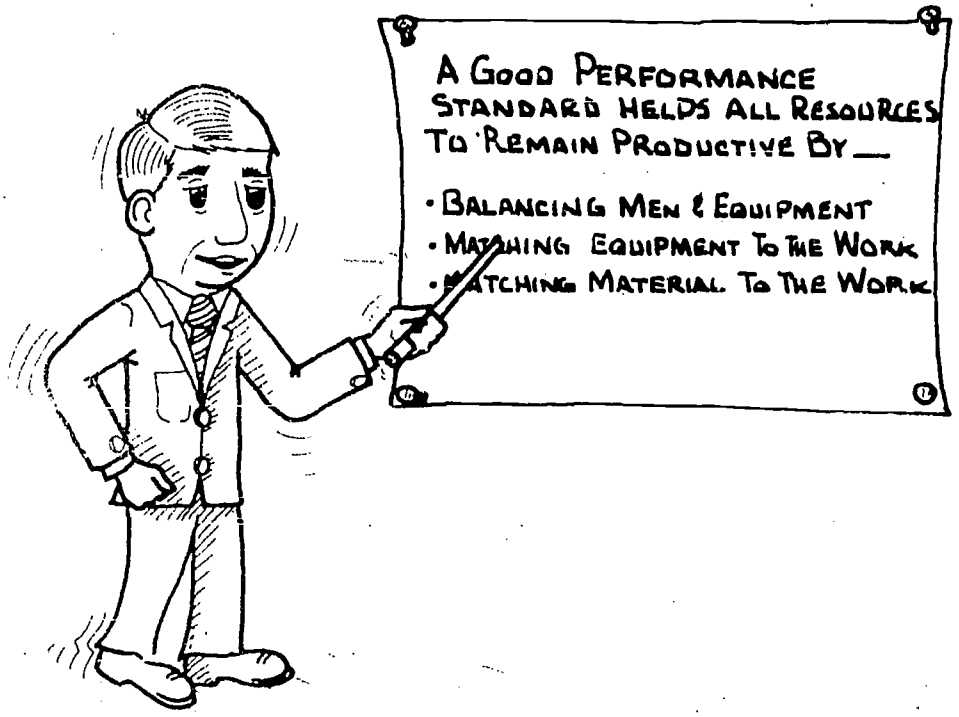
There is a better choice in Frame 35.

38

No. If conditions changed slowly, it would probably be best to do things correctly and carefully the first time. But, as you know, many things are changing very rapidly these days. Since the pace of change is moving faster, the Department probably is wise not to work long and hard at developing standards which may need to be changed anyhow in a short time.

Standards should be developed and released quickly. Rough and imperfect guidelines are better than well polished standards which are out of date.

Go back to Frame 35 and make another choice.



39

Section Two

PRINCIPLES IN PERFORMANCE STANDARDS

When developing performance standards, the head office considers the qualities performance standards should have. The desirable qualities are really quite simple. Let's see some of them in an example.

39 (continued)

Suppose Irving, a foreman, goes out with four men to correct some base failures on paved shoulders. They drive to the site in two pickups, two dump trucks and one combination front end loader and backhoe. From just this information, what is wrong with this situation, if anything?

A.	From what is given, nothing is wrong.	Go to Frame 40.
B.	There are too many men assigned to this activity.	Go to Frame 41.
C.	There are too many pieces of equipment.	Go to Frame 42.

40

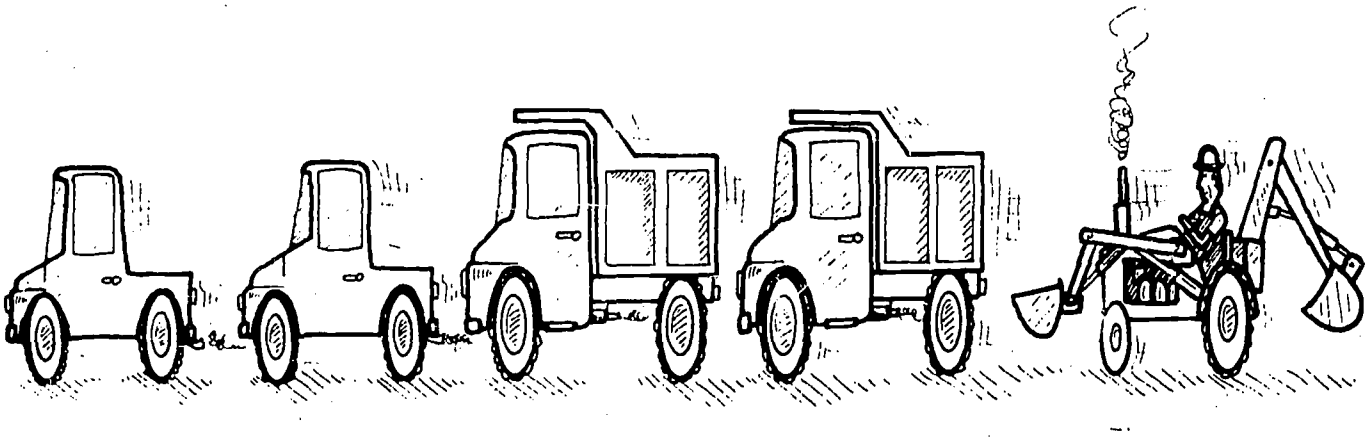
Something is wrong. There are five men in Irving's crew, counting Irving, himself. There are also five pieces of equipment. Think about that.

Go to Frame 39 and make another choice.

41

Too many men? No, five men probably can be kept pretty busy on a base repair operation. A couple of men can use the picks, shovels, brooms and other hand tools. One man can operate the backhoe and front end loader and two men can operate the dump trucks.

There's a better answer. Go to Frame 39 and find it.



42

Right. There is no need for each of the workers to drive a vehicle to the work site. Why the second pickup truck? Only one pickup is needed to bring the hand tools and a couple of men. The other pickup is not needed and probably not even used. And that's the point here:

THE NUMBER OF MEN AND PIECES OF EQUIPMENT MUST BE BALANCED...

It is obvious that the Department saves more money if all its men are productive eight hours a day. It is less obvious -- but nevertheless true -- that the Department saves money if all its equipment is as productive as possible. The ideal situation is to have no man wait for a slow machine to catch up, and no machine have to slow down because of not enough manpower.

42 (continued)

Suppose one pickup truck is removed from Irving's crew. Now the driver of that truck must ride to the site with one of the other drivers. Does this step solve the balance problem?

A.	To some extent, yes. But Irving really needs more men.	Go to Frame 43.
B.	Yes. Now the situation is pretty good.	Go to Frame 44.
C.	Probably not. At least one more vehicle should also be removed.	Go to Frame 45.

43

Probably right. Two men can use the pick, shovel and other hand tools. Two men can drive the two dump trucks, and one man can operate the front end loader and backhoe. Almost certainly a flagman is needed and maybe an extra laborer.

Go to Frame 46.

44

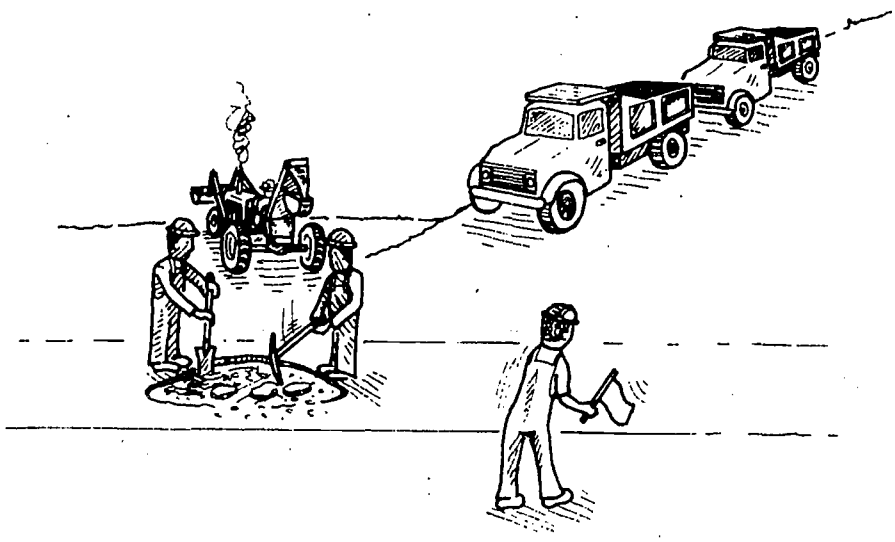
The situation is better than it was, but it's not quite good enough yet. If two men operated dump trucks, and one man operated the combination loader and backhoe, there would be two men left to do all the manual work and the flagging. Is that enough?

Go to Frame 42 and answer the question again.

45

This is the wrong answer. There may be cases where one of these vehicles is not needed but they would not be the usual cases. For instance, maybe the haul distance is so short that only one dump truck is needed. Maybe the site is so close to the garage that the pickup truck isn't needed. These are not normal situations.

Go to Frame 42 and choose again.



46

The next scheduled base repair job was shoulder work on a four-lane divided highway. Another foreman, Ray, got the assignment. Ray set out with:

+ Seven men,
+ Two dump trucks,
+ One front end loader with a $1\frac{1}{2}$-yd bucket, and
+ One backhoe with a $\frac{1}{2}$-yd bucket.

46 (continued)

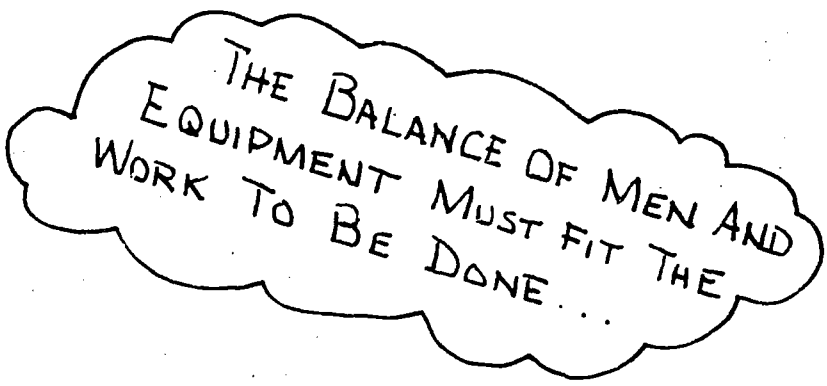
Ray had three men doing manual labor, two driving dump trucks, one operating the backhoe, and one flagman. Ray, himself, operated the loader.

Is Ray's situation better than Irving's?

A.	It's hard to say; they both need corrections.	Go to Frame 47.
B.	Yes. He seems to have enough men to keep the equipment working.	Go to Frame 48.
C.	No. Ray is using too much equipment.	Go to Frame 49.

47

They both need corrections, right. Irving had too many vehicles and not enough men. Ray has enough equipment for the manpower and enough manpower for the equipment, but probably not enough work to justify the sizes of the loader and backhoe. And that's the second point:



47 (continued)

If the job is big, a big crew and heavy equipment may be needed. But if it's an ordinary job, there's no need for a $1\frac{1}{2}$-yard bucket on a loader. A bucket half that size will do the job.

Go to Frame 50 for a third example.

48

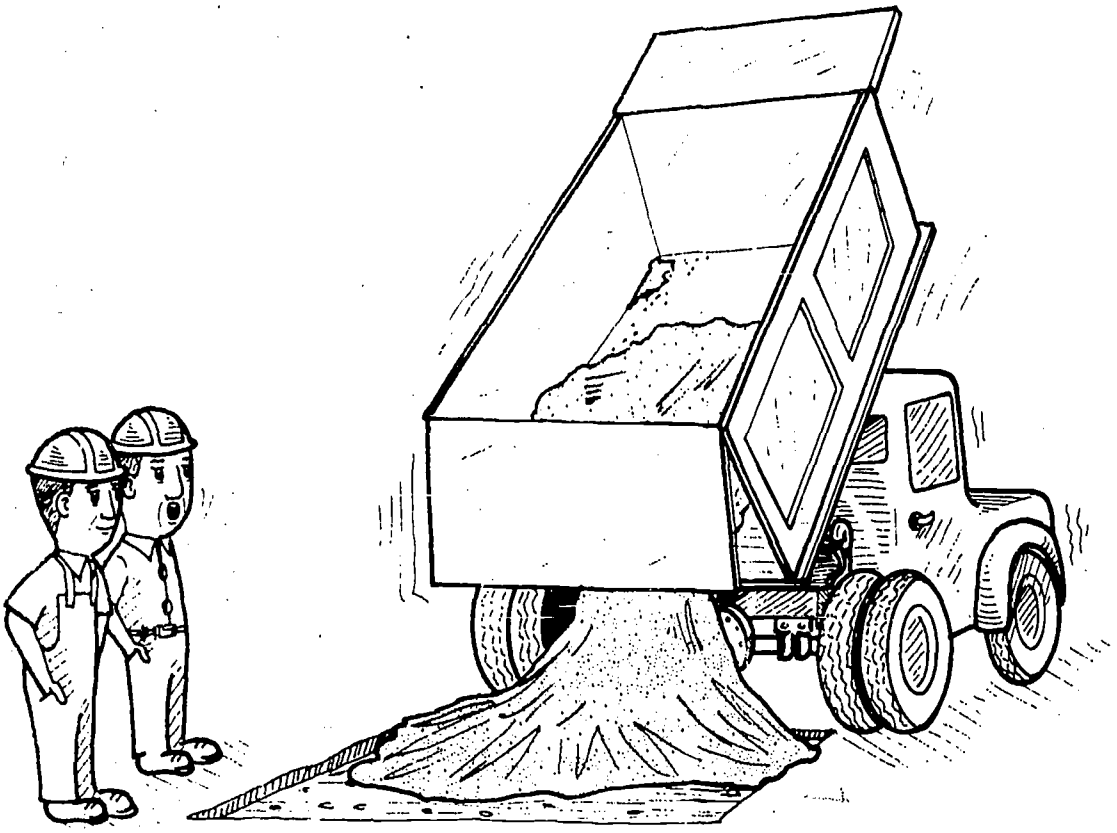
This answer is not the best one. Ray has enough men for the equipment, but he also has a problem. He has big equipment and his crew seems to be capable of doing a big job. But no mention has been made of the job size. This equipment and crew are too heavy for average shoulder base patching.

Go to Frame 46 and make another choice.

49

True, Ray's equipment is too much for the average shoulder base patching job, but it's hard to say whether this imbalance is more or less desirable than Irving's.

There's a better answer. Go to Frame 46 and choose it.



50

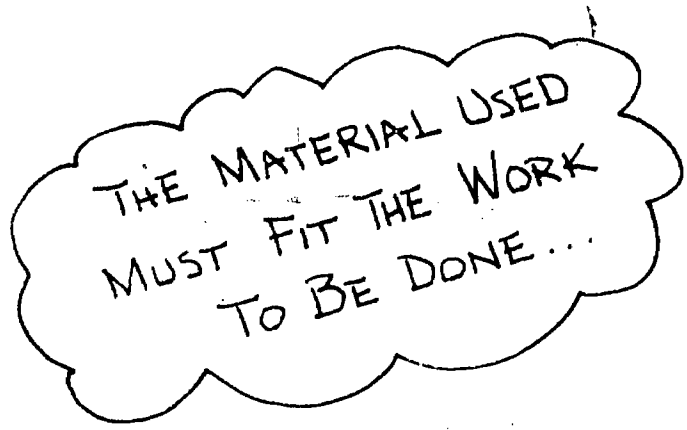
One more base repair job:

Norman went with seven men to repair the base of a paved shoulder. The crew used one pickup, two dumps and a tractor equipped with a front end loader and backhoe. Norman had the bad base material replaced with sand. Is there anything wrong with this situation?

A.	Yes, sand is not a good base material.	Go to Frame 51.
B.	No, it seems to be in line with the points of this section.	Go to Frame 52.

51

Right. The usual base material is gravel or crushed stone. Sand is too shifty to be a good base material. And this is another point of this Section:



Sand certainly has its uses, but it is not the best base material. The material must be best suited to the work, or else the cost of the work will rise. If sand is used on the base repair job, for example, the work probably will have to be redone in a short time -- an unnecessary expense.

Go to Frame 53.

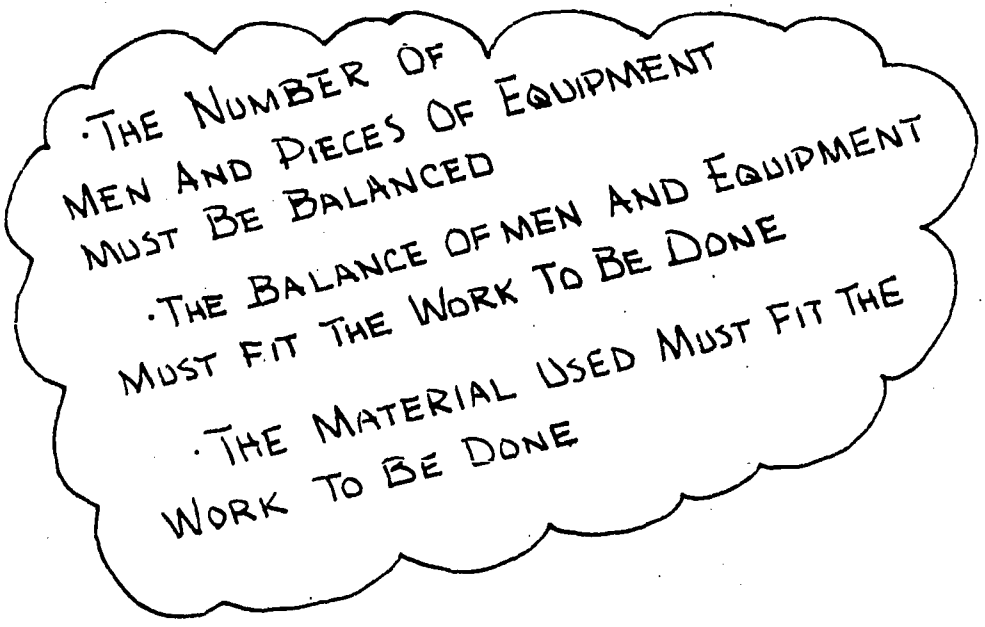
52

The situation as described is in line with the points covered so far. But a new point is being made now and it concerns materials.

The foreman was using sand as a base material. But sand usually is not a base material, right?

Go to Frame 51.

Here are the three main points again:



To sum up these three points, let's say that resources -- men, equipment and materials -- should be balanced on performance standards. For example, it means if laborers can handle one truckload of material every ten minutes, there should be enough trucks to bring in loads every ten minutes. If gravel is the best material to use, gravel should be used; and if a three-ton dump truck is big enough, a five-ton dump truck shouldn't be used.

The main purpose of these three points is to:

A.	Keep all resources productive.	Go to Frame 54.
B.	Save the Department money while doing good work.	Go to Frame 55.
C.	Have the best possible work done.	Go to Frame 56.

54

This is not a wrong answer, but it's not the best answer. Why should the men and equipment be kept productive? Is it for the men's safety? Is it for the equipment's longevity? Does this policy promote better workmanship? Why should the resources be kept productive? If you answer this question honestly, you'll have the right answer.

Go back to Frame 53 and try again.

55

Right. These points help get the best compromise of work that is done fast, done well, and done most economically. How? Because a performance standard lists the best combination of resources -- men, equipment and materials -- for an average job.

Look at part of a typical performance standard below. This part shows only the resource combination.

PART OF A PERFORMANCE STANDARD
FOR PATCHING BASE

CREW SIZE:	7 (add flagmen as needed)
EQUIPMENT:	3 Dump Trucks
	1 Pickup Truck
	1 Gradall
	1 Rubber Tire Roller
MATERIAL:	Pit Run Gravel

55 (continued)

What is the standard manpower level for a base patching operation?

A. Seven. Go to Frame 57.

B. Eight. Go to Frame 58.

C. Nine. Go to Frame 59.

56

Here again the problem of finding a happy medium shows up. If these pointers are aimed at getting very high quality work done, maybe all the necessary work won't be done. Maybe a few activities will be performed with excellent results, but no more time remains in which to do the rest of the work.

Good work is a very worthy goal. But time and cost considerations are also necessary. Go to Frame 53 and make another choice.

57

Right. Seven is the standard manpower level. But a standard's guidelines are flexible. They are based on an average-sized job under average conditions. The supervisor must fit the guidelines to the prevailing conditions. If traffic is heavy, flagmen have to be added to the basic crew. Often, haul distance or haul time cycle determines the number of trucks needed.

57 (continued)

Remember: A performance standard presents guidelines. It is the starting point for determining the resource combination for each job.

Go to Frame 60.

58

If one flagman is used, the total crew size is eight. But eight is not the standard crew size.

Check that part of a performance standard again. Then choose another answer from Frame 55.

59

No. If two flagmen are used, then the total crew size will be nine. But nine is not the standard crew size.

Check that part of the performance standard again. Then choose another answer from Frame 55.

60

Here is part of another performance standard.

EQUIPMENT:	2	Dump Trucks	(based on a 40 minute haul cycle)
	1	Gradall	

Suppose that in a particular case the haul cycle were one hour. How many dump trucks would be required?

A. Only one. Go to Frame 61.

B. Two. Go to Frame 62.

C. Three. Go to Frame 63.

61

No. The standard says 2 trucks are needed for a 40 minute haul cycle. If the haul cycle takes longer than 40 minutes, you need to add trucks not subtract them. After all, you don't want that Gradall idle any more than is absolutely necessary.

Go back to Frame 60 and make another choice.

62

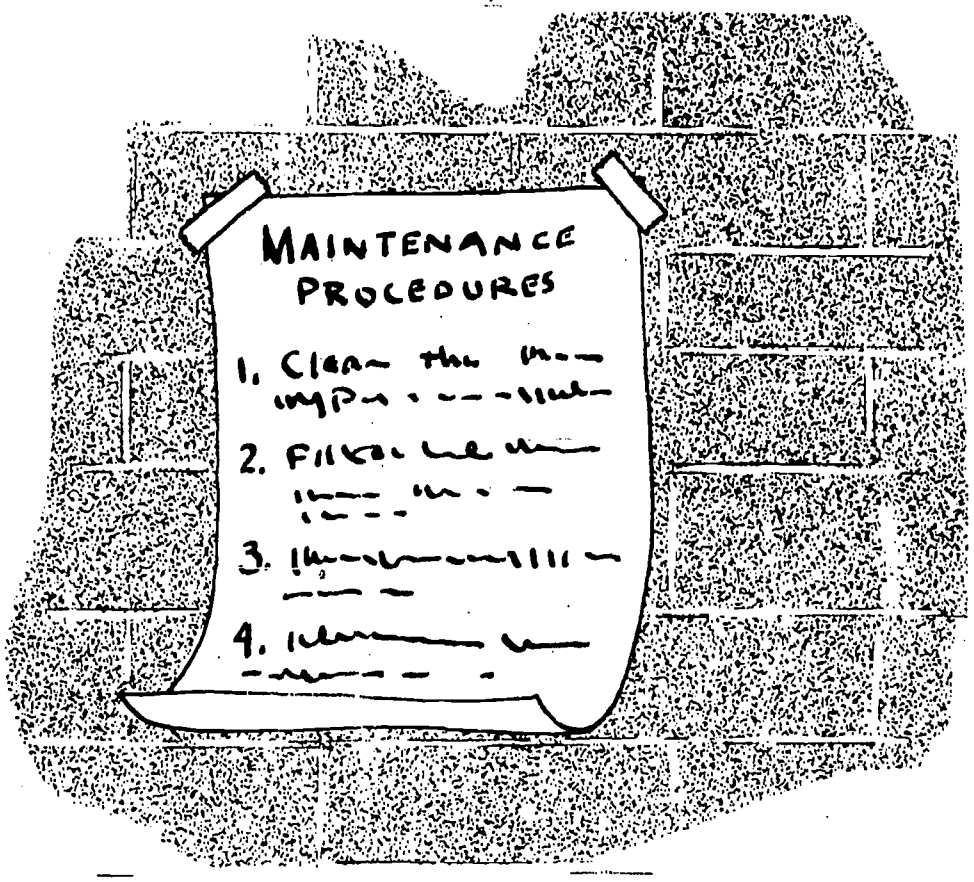
No. The standard says that two trucks are used if the haul cycle is 40 minutes. If the haul cycle is 60 minutes, the Gradall will spend 20 minutes waiting each cycle. So, you need another truck.

Go on to Frame 63.

63

Right. If the haul time increases, the number of trucks must increase to keep a steady flow of material. In this case the standard might be better if it read "One dump truck for every 20 minutes in the haul cycle." The important thing here is that standards must outline balanced resources, and do so clearly and simply. Balancing resources -- men, equipment and material -- is important because it makes sure that as much work as possible is done as well as possible at the lowest possible cost. And outlining such resources clearly is important because unless the guidelines are cleor they can't be followed. So much for resources.

Go to Frame 64.



64

Besides balancing the resources, performance standards also suggest a procedure for performing the operation. The recommended procedure is the best known method of doing the job with the given resources. Generally a procedure is dependent on the manpower level and the equipment.

Here is the part of a performance standard for patching base with the recommended procedure added.

PART OF A PERFORMANCE STANDARD
FOR PATCHING BASE

CREW SIZE: 7 (add flagmen as needed)

EQUIPMENT: 3 Dump Trucks
1 Pickup Truck
1 Gradall
1 Rubber Tire Roller

MATERIAL: Crushed Concrete, Pit Run Gravel or Aggregate

RECOMMENDED PROCEDURE:

1. Cut out surface failures with Gradall or other suitable equipment.

2. Remove unsatisfactory base or subgrade material.

3. Load unsatisfactory material into truck, haul away and dispose at predesignated area.

4. If water under the pavement caused failure, build a small trench out to the ditch and fill with coarse granular material before resurfacing.

5. Place new base material in layers in cut-out section.

6. Compact each layer with hand tamps and roller.

7. The final layer should be compacted level with surrounding base.

8. Replace surfacing as under Activity No. 105.

64 (continued)

Are there instances when a procedure different from the recommended one should be followed?

A. Yes. Go to Frame 65.

B. No. Go to Frame 66.

65

"Yes" is the right answer. The recommended procedure on a performance standard depends on the resource balancing. Should extra manpower be needed or more or heavier equipment used, the procedure also might change.

In general, a performance standard gives some leeway in its guidelines. If the equipment and crew size vary too much, the activity usually is broken into two or three separate standards. An example might be a sealing operation. It is possible to have a crew size of anywhere from seven to maybe 20 men. And equipment can range from six or seven light pieces to 11 or 12 relatively heavy pieces. This kind of work -- sealing -- should be described as two activities -- with two separate performance standards: one for spot sealing (smaller crew, lighter and less equipment); one for seal coating (larger crew, more and heavier equipment).

Generally the head office is very careful not to go to the opposite extreme and make a separate standard for every slight variation in the job. The danger here is the tendency for field personnel to interpret each standard too rigidly. The result may be twofold:

1. Standards are then seldom used because they seldom fit the described situation exactly, and

65 (continued)

2. Because of the number of standards and red tape involved, it's more trouble for field personnel to try to follow the standards than it is to go out and do the work the best they can.

Above all, the head office wants standards that (1) represent the best way to do a job and (2) are easily understood and easily followed.

Go to Frame 67.

66

Wrong. If resource combinations can change with circumstances, why can't recommended procedures also change?

Read Frame 65.

67

The combination of balanced resources and recommended procedures gives reasonably consistent results in terms of accomplishment.

67 (continued)

A performance standard includes a set of guidelines for accomplishment. These guidelines include a definition of the unit in which the accomplishment is expressed, an estimate of the number of units of work to be accomplished in a day, and the average productivity.

Here is the accomplishment section of a typical performance standard for patching base.

ACCOMPLISHMENT

UNIT: Cubic yard

DAILY PRODUCTION: 45-50 cubic yards

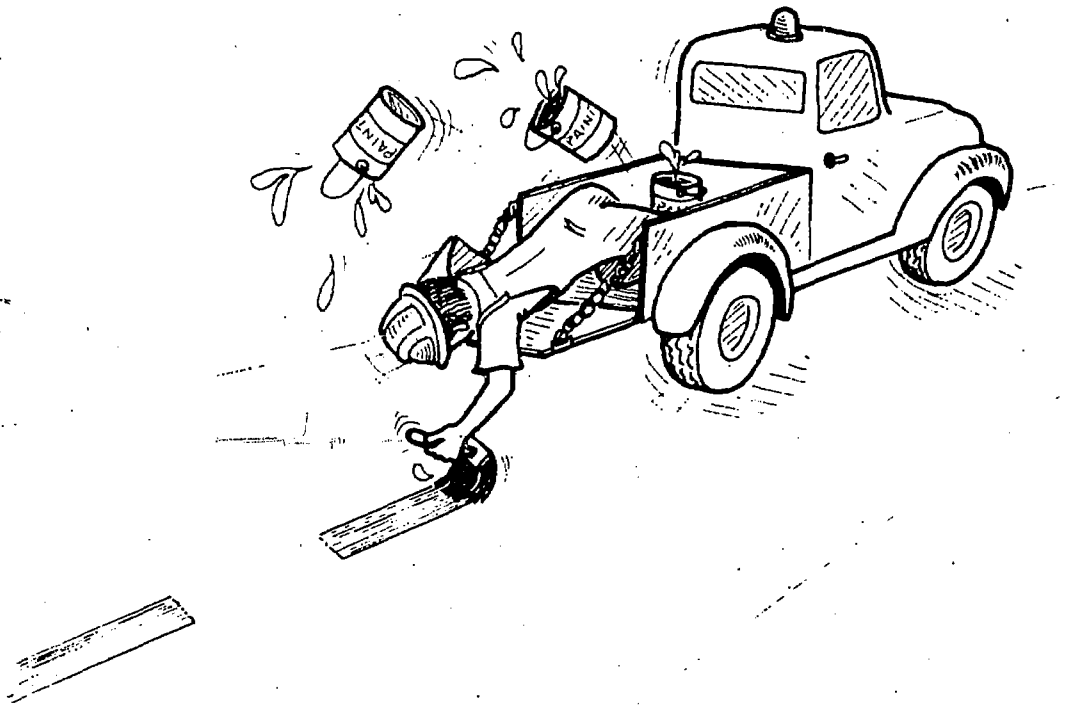
AVERAGE PRODUCTIVITY: 1.2 man-hours per cubic yard

The work unit is a quantity that measures what was done or the materials used or the man-hours needed to do the work. Accomplishment in the base patching example is measured by the amount of material used.

Usually the unit of work chosen for each activity:

A.	Is based on results and what is most practical.	Go to Frame 68.
B.	Describes results.	Go to Frame 69.
C.	Describes what went into the job.	Go to Frame 70.
D.	Is man-hours.	Go to Frame 71.

Right. If measuring the result is most practical (and it usually is), work should be measured in units describing the results. An example would be painting the center stripe on a highway.



What is the result of this activity?

A. The amount of paint used. Go to Frame 72.

B. The number of man-hours spent on the operation. Go to Frame 73.

C. The miles of road striped. Go to Frame 74.

69

Describes results? Yes, whenever possible, the work unit describes the results of an activity -- or, what was done. But it's not always possible or even practical for a work unit to always describe results.

Go back to Frame 67 and try to complete the sentence better.

70

Not always. Describing what the workers did to complete an operation isn't always a meaningful way of describing accomplishment. It simply isn't practical for a work unit to always describe results, or work effort, or material used, or man-hours.

Choose another answer from Frame 67.

71

Sometimes man-hour is the most practical work unit for an activity. But most of the time, accomplishment is measured in other ways.

Choose another answer from Frame 67.

72

This is not the result. And the amount of paint used to paint the center stripe on a highway is not the most practical unit of measurement.

Go to Frame 74.

73

No. The question asked for the result of an activity. It is not man-hours.

Go back to Frame 68.

74

Right. The result of this activity is the number of miles of road striped and it is the most practical unit of measurement here.

But what about street painting in an urban area? The work can't be measured adequately by counting the miles painted. Here the practical unit is material -- or gallons of paint used. And finally some work is very hard to measure in any units other than units of time spent at the work. Such activities include hand trimming of grass near posts and signs and removing abandoned automobiles and animal carcasses.

Go to Frame 75.

The last two items in the accomplishment section are the daily production and average productivity.

The number of units of work expected to be accomplished in a full day is the "daily production." This guideline usually is given as a range of values. And daily production within that range usually is acceptable.

The average productivity guideline is the number of man-hours required to accomplish one unit of work.

But productivity is not a big source of worry. At least it shouldn't be. If the resources are balanced and the recommended procedure is followed, the productivity rate should be satisfactory.

Go to Frame 76.

Section Three

MAINTENANCE STANDARDS

76

Usually all the standards that field personnel need and can use are found on a printed form labeled "Maintenance Standard." A maintenance standard identifies the operation, gives a brief description of its purpose and contains all the parts of a performance standard. Look at the sample on the next page.

Does this sample include more than the above description says it does?

A. Yes, it contains several more bits of information. Go to Frame 77.

B. No, it looks as if it contains everything it should, but no more. Go to Frame 78.

MAINTENANCE STANDARD

April 17, 1972 JOINT AND CRACK FILLING Activity No. 101

DESCRIPTION AND PURPOSE:

Cleaning and filling with liquid sealant, asphalt surface cracks which are greater than ¼-inch wide.

SCHEDULING:

Schedule this work when the temperature is not expected to be above 50°F.

TYPE OF ACTIVITY:

Routine Maintenance

CREW/EQUIPMENT

Recommended Crew Size: 7

(Add flagmen as needed.)

Equipment:

No.	Description	Group
2	Trucks	03
1	Truck	02
1	Asphalt kettle (600 or 300 as avail.)	36
1	Compressor	19

(Flashing arrow, truck or trailer mounted, may be added as needed for traffic control.)

ACCOMPLISHMENT

Work Unit: Gallon of sealant

Daily Production: 100-250 gallons

Average Productivity: 0.4 man-hours/gallon of sealant

MATERIAL

Sealant
Sand or 31C (3/8" stone maximum)

RECOMMENDED PROCEDURE:

1. Before filling, clean cracks with air compressor.
2. Apply sealant heated to the specified application temperature.
3. Fill cracks to within ¼ inch of the top of the surface to allow for expansion.
4. To prevent tracking, blot with sand or 3/8" stone -- depending on width of joint or crack.

CRITERION -- ONLY CRACKS GREATER THAN ¼-INCH (PENCIL DIAMETER) WILL BE FILLED.

77

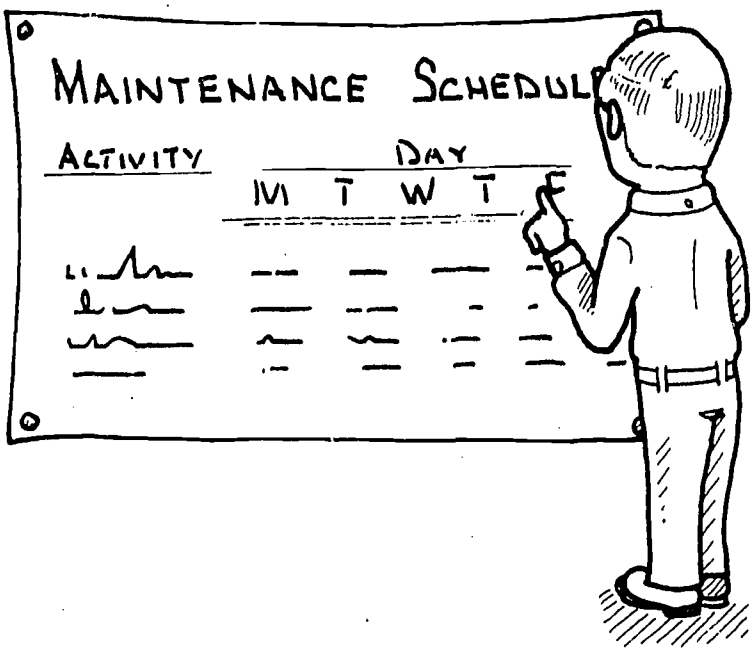
Right. It contains a note on scheduling, some sort of activity type, workmanship goal and also the quality standard. Let's look at each of these.

Go on to Frame 79.

78

No. Look again. The maintenance standard contains more than just the activity name and description, and the parts of a performance standard. There are categories called "scheduling" and "type of activity," and we haven't mentioned those subjects yet. This maintenance standard also contains a quality standard and workmanship goal. Let's look at each of these items.

Go to Frame 79.



SCHEDULING

Most maintenance standards contain some sort of scheduling note. These notes simply recommend when or when not to perform the activity. This is certainly information that field personnel can use.

Which of the following statements could not be a scheduling note on a maintenance standard?

A. For premix patching: Schedule as soon as possible after noticing pothole. Go to Frame 80.

B. For seal coat: Do not schedule during winter months. Go to Frame 81.

C. For reshaping shoulders: To be performed only if the shoulder needs it. Go to Frame 82.

D. All of the above statements could be scheduling notes. Go to Frame 83.

80

The question asked which of the statements could not be a good scheduling note, but the choice you made happens to be wrong. Potholes are hazardous, so patching them should be scheduled as soon as possible.

Go to Frame 79 and try again.

81

This is a wrong choice. The note about scheduling a seal coat operation is a good one. Remember, you're looking for a note which is not helpful in scheduling work.

Go to Frame 79 and try again.

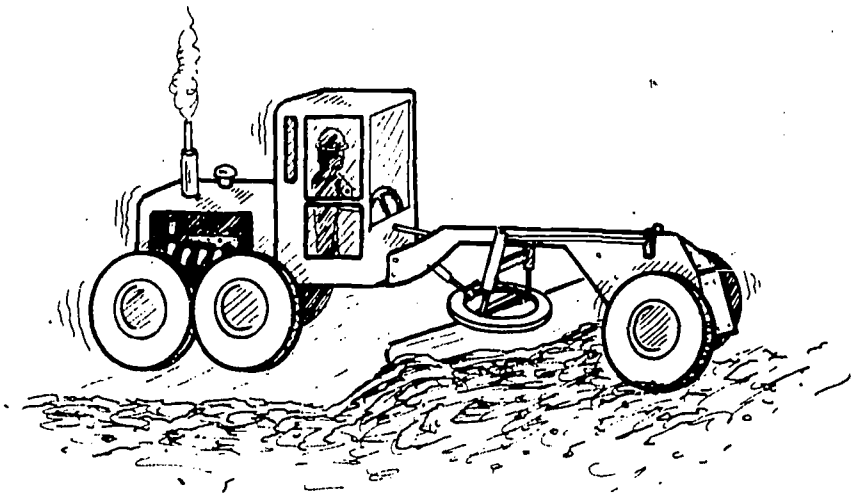
82

Right. All work should be performed only if needed. So this note on reshaping shoulders says nothing new. It says nothing that is helpful to a supervisor who schedules work. It provides no guidelines.

Go to Frame 84.

83

Not true. There is one statement in Frame 79 which would not make a good scheduling note on a maintenance standard. Go back and find it.



TYPE OF ACTIVITY

Most departments have some sort of classification of activities. It isn't absolutely necessary, but it often helps. In such a system the following three categories are usually included: routine, emergency and special.

Routine work is work which can be regularly scheduled. It is the day-to-day ordinary maintenance. Examples of work in this category are mowing, reshaping non-paved shoulders and joint and crack filling.

Emergency work is work which must be done as soon as possible to correct a hazardous condition. Approval from the head office is not necessary. Pothole patching and snow removal are examples.

Special work is usually time and money consuming work which needs to be officially approved by the head office. Examples might be overlay jobs and seal coats.

84 (continued)

A certain operation is described as "replacement and/or realignment of damaged steel beam guardrail sections, posts and hardware as a result of traffic accidents." In what category does this operation fit?

A.	Routine.	Go to Frame 85.
B.	Emergency.	Go to Frame 86.
C.	Special.	Go to Frame 87.

85

Routine? No, because accidents which damage guardrails aren't routine happenings. Furthermore, once a guardrail is damaged, it should be repaired as soon as possible. That doesn't sound like routine work.

Go to Frame 84 and choose again.

86

Right. When a guardrail is damaged, it leaves a traffic safety hazard which should be corrected as soon as possible. Replacing guardrails is probably emergency work.

Go to Frame 88.

87

Special? No, because replacing or repairing guardrails isn't time consuming, isn't usually expensive, and doesn't usually need head office approval.

Go to Frame 84 and make another decision.

88

A maintenance standard almost always contains some elements of the quality standard. A quality standard, remember, answers the question, "How bad should a condition be before it should be repaired?"

88 (continued)

In the maintenance standard on the next page, there are several places that might be considered as part of a quality standard and a "workmanship" goal. Where are these places?

A.	In the recommended procedures section.	Go to Frame 89.
B.	In the description and purpose section.	Go to Frame 90.
C.	In the scheduling note.	Go to Frame 91.
D.	All of the above, primarily the second.	Go to Frame 92.

MAINTENANCE STANDARD

April 17, 1972 | JOINT AND CRACK FILLING | Activity No. 101

DESCRIPTION AND PURPOSE:

Cleaning and filling with liquid sealant, asphalt surface cracks which are greater than ¼-inch wide.

SCHEDULING:

Schedule this work when the temperature is not expected to be above 50°F.

TYPE OF ACTIVITY:

Routine Maintenance

CREW/EQUIPMENT

Recommended Crew Size: 7

Equipment:

No.	Description	Group
2	Trucks	03
1	Truck	02
1	Asphalt kettle (600 or 300 as avail.)	36
1	Compressor	19

(Flashing arrow, truck or trailer mounted may be added as needed for traffic control.)

ACCOMPLISHMENT

Work Unit: Gallon of sealant

Daily Production: 100-250 gallons

Average Productivity: 0.4 man-hours/gallon of sealant

MATERIAL

Sealant
Sand or 31C (3/8" stone maximum)

RECOMMENDED PROCEDURE:

1. Before filling, clean cracks with air compressor.
2. Apply sealant heated to the specified application temperature.
3. Fill cracks to within ¼ inch of the top of the surface to allow for expansion.
4. To prevent tracking, blot with sand or 3/8" stone -- depending on width of joint or crack.

CRITERION -- ONLY CRACKS GREATER THAN ¼-INCH (PENCIL DIAMETER) WILL BE FILLED.

89

Maybe. The "Recommended Procedure" section describes workmanship goals: the sealant should come to within $\frac{1}{4}$-inch of the roadway surface, and the sealant shouldn't be spilled onto the surface.

But workmanship goals are not exactly the same as quality standards.

Try another answer -- in Frame 88.

90

Yes! The description and purpose note mentions "filling...cracks which are greater than $\frac{1}{4}$-inch wide." This is a quality standard. There are other sections of the maintenance standard which explain more about quality standards and workmanship goals.

Go to Frame 88 and choose another answer.

91

The scheduling note says that the temperature should be below 50°F when this activity takes place. That sounds like a small part of a quality standard. But there are other places which specify the quality standard, and one place does it better than the scheduling note.

Go to Frame 88 and make another choice.

92

Right. The "Description and Purpose" section gives the condition which must be met to justify this work -- cracks must be more than $\frac{1}{4}$-inch wide.

The "Recommended Procedure" section describes the workmanship goal. The sealant should come to within $\frac{1}{4}$-inch of the roadway surface. It shouldn't be spilled onto the roadway surface, and the crack should be lightly sprinkled with sand.

Most maintenance standards contain elements of quality standards and workmanship goals. Do they also contain parts of the quantity standard?

A. Yes. Go to Frame 93.

B. No. Go to Frame 94.

93

No. Maintenance standards do not contain any quantity standards. Since quantity standards are used mainly for work program and budget preparation, field personnel have no use for them. So, the maintenance standards don't contain them.

Go to Frame 95.

94

Right. Since quantity standards are used chiefly to prepare work programs and the budgets, field personnel don't have much need for them. So, the maintenance standards don't show quantity standards.

Go to Frame 95.

REVIEW

This review covers Part Two of this training unit. Answer the questions below. Then check your answers with those given in Frame 96.

1. The purpose of considering safety, preservation, appearance, how standards can be applied and public opinion is:

   A. To determine the best method to use to develop standards.

   B. To gain the reputation of using good judgment.

   C. Because it's easier to make standards that way.

   D. To develop the best possible standards.

2. Quality standards are easier to follow if they:

   A. Are quantitative -- express an amount.

   B. Include a mathematical calculation.

   C. Show evidence of thorough research.

   D. They leave a lot of room for interpretation.

3. The three main parts of a quantity standard are:

   A. Roadway feature, time period and equipment estimate.

   B. Time period, equipment estimate and manpower estimate.

   C. Work estimate, roadway feature and time period.

   D. Work estimate, roadway feature and manpower estimate.

4. Which of the following statements contains enough information to serve as a quantity standard?

   A. In crack filling operations the Department uses 12,000 gallons of sealant per year.

   B. In seal coat operations, the Department seals 1/5 of a lane-mile for every lane-mile each year.

   C. The Department's shoulder patching activities use $\frac{1}{2}$ cubic yard of gravel per shoulder mile.

   D. The Department's ditch reshaping activity is measured in ditch-miles per year.

5. What can be said about the methods used to develop each kind of standard?

   A. Any method can be used to develop standards.

   B. There is only one basic method of developing good standards.

   C. There are many ways of developing good standards, but they all have the same basic considerations.

   D. None of the above answers are correct.

6. The performance standard for spot sealing recommends a crew-size of seven men and two dump trucks. But the understanding is that one truck is needed for every 20 minutes in the haul cycle. What effect would a 60-minute haul cycle have on the standard?

   A. It would change the number of trucks recommended.

   B. It would change the crew size and the number of trucks.

   C. It would have no effect.

   D. The standard could not be followed in this case.

7. The combination of balanced resources and recommended procedure on a maintenance standard usually means that _____ will be satisfactory.

   A. Workmanship.

   B. Work quality.

   C. Accomplishment.

   D. All of the above answers are correct.

   E. None of the above answers are correct.

95 (continued)

8. Which of the following is not contained in a maintenance standard?

A. Quality standard.

B. Quantity standard.

C. Performance standard.

D. Workmanship goal.

96

Here are the best answers to the questions in Frame 95. Compare your answers with these:

Question	Answer	Statement
1	D	The purpose of considering all five factors (safety, preservation, appearance, how standards can be applied and public opinion) is to develop the best possible standards.
2	A	Quality standards are easier to follow if they are quantitative -- express an amount.
3	C	The three main parts of a quantity standard are the work estimate, roadway feature and time period.
4	B	The statement that contains enough information to serve as a quantity standard is, "In seal coat operations, the Department seals 1/5 of a lane-mile for every lane-mile each year.
5	C	There are many ways of developing good standards, but they all have the same basic considerations.

96 (continued)

Question	Answer	Statement
6	B	The effect of a 60-minute haul cycle on a standard that called for two dump trucks (one for every 20 minutes on the haul cycle) would be a change in both the crew size and the number of trucks.
7	C	The combination of balanced resources and recommended procedure usually means that accomplishment will be satisfactory.
8	B	A quantity standard is not included in a maintenance standard.
