SUBCOURSE QM5091 | EDITION 2

SCHEDULE AND DISPATCH PETROLEUM PIPELINE OPERATIONS

AIPD

READINESS/ PROFESSIONALISM THRU GROWTH

THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM

SCHEDULE AND DISPATCH PETROLEUM PIPELINE OPERATIONS

Subcourse QM 5091
Edition 2

Unites States Army Combined Arms Support Command
Fort Lee, VA 23801-1809

2 Credit Hours

CONTENTS

The passing score for this subcourse is 70%.

INTRODUCTION

This subcourse is designed to train a 76W50 soldier on how to conduct scheduling and dispatching operations on a petroleum pipeline. We will cover each part of the task and what your responsibilities are when scheduling and dispatching petroleum products through a petroleum pipeline.

Two credit hours will be awarded for successful completion of this subcourse.

LESSON

TASK: 101-519-5110. Schedule and Dispatch Petroleum Pipeline Operations. As a result of successful completion of this subcourse, you will be able to perform the following performance measures:

1. Prepare a consumption graph.

   a. Plot the storage capacity for the product in thousands of barrels (vertical axis) against the time in monthly intervals (horizontal axis).

   b. Figure from 0001 of one day to 0001 of the next.

   c. Plot a 5-percent vapor space at the top of the graph.

   d. Plot a four day safety level at the bottom of the graph.

   e. Draw a broken line for calculated issues and receipts.

   f. Draw a solid line for actual issues and receipts.

   g. When projecting tank cleaning, subtract the capacity of the tank(s) from the total capacity and indicate this on the graph.

2. Direct batching sequence. Schedule products to generate usable interfaces by arranging aviation gasoline, motor gasoline, aviation turbine fuel, kerosene, and diesel fuels in the pipeline.

3. Prepare a monthly pipeline schedule.

   a. Prepare the chart on a sloping table top, which can be equipped with a parallel rule.

   b. Determine the number of hours the line is to operate each day. Show time from the beginning to the end of one working day.

   c. Draw one inch for each hour of a 24-hour period. Represent the time period on the vertical axis.

d. Represent the line fill in distance in barrels on the horizontal axis. One inch will represent 100 barrels.

e. Show terminals by their respective line fill distance downstream from the base terminal. Plot them vertically on the chart.

f. Provide each batch with a different batch number when it is put into the pipeline.

g. Provide a new batch number for product taken from the line at intermediate terminals and then put it back into the line.

h. Use different color codes for different types of product. EXAMPLE: AVGAS, blue; MOGAS, red; JP-4, green; kerosene, yellow; and diesel, brown.

i. Divide the pumping rate into the distance in barrels to determine the numbers of hours it will take a batch to reach a designated place.

j. Draw a solid sloping straight line to indicate no intermediate terminal stripping.

k. Change the angle of sloping line to indicate intermediate terminal stripping.

l. Draw a broken vertical line when stripping action is to occur.

NOTE: The points at which the sloping lines intersect with the vertical lines representing terminals and stations indicate the scheduled arrival times. When you have drawn all the throughput lines, you will have represented all the scheduled pumping and delivery operations for the month.

4. Prepare a daily pumping schedule.

a. Transfer data from the monthly schedule in an abbreviated, tabular form for the days concerned.

b. Show changes.

c. Show emergency requirements.

d. Prepare the schedule a week in advance so that the dispatching section can be flexible in establishing its operations.

5. Give the completed graphs and schedules to your operations sergeant as each one is completed.

CONDITION: You are a senior petroleum NCO responsible for scheduling and dispatching products through petroleum pipelines. You must perform this task in a petroleum terminal setting or simulated combat situation under all environmental conditions.

STANDARD: You must answer 70 percent of the written exam questions correctly to receive credit for this subcourse.

CREDIT HOURS: See page ii, Introduction.

REFERENCES: FM 10-18, (Petroleum Terminal and Pipeline Operations), chapters 7 and 8.

LESSON TEXT

1. GENERAL. In order to provide the vast quantities of bulk fuels required by the military today, the use of pipelines is essential. Pipelines are currently the fastest and most economical means of transporting bulk petroleum products to using units. As a senior petroleum NCO, you must be able to plan (schedule) the future movement of these products through a pipeline. You mist also be able to direct the actual movement of (dispatch) the fuel at the desired time, in the proper quantity and also in the proper sequence. Scheduling is based on estimated requirements and availability of products. These estimates are translated into schedules that serve as the basis for daily pumping instructions. To prepare a forecast for any given number of days, you must have some means of determining when certain products will be required, where they will be required, the amount of available storage space, and the length of time it will take for the product to reach its destination after it has been started through the pipeline. Past issue records are the best means of determining the daily requirements throughout the pipeline system. Knowing the daily requirements, available storage space along the line, and quantity of product authorized to be on hand at the various terminals, you can then prepare consumption graphs (para 2), which show projected consumption and deliveries. You must prepare two schedules, a monthly pipeline schedule (para 4) and a daily pumping schedule (para 5).

2. CONSUMPTION GRAPHS.

a. Purpose. A consumption graph (fig 1) provides you with required data needed to prepare your monthly and daily schedules. It also provides you with current quantities on hand and storage capacities. Consumption graphs should be maintained in the main distribution office for each product handled at each storage point, and each terminal should maintain similar graphs for large volume users. These graphs are available for visualizing present and future stocks and storage positions and for revealing trends in consumption. Sudden increases or decreases in consumption are apparent immediately and scheduling adjustments can be made.

b. Preparation of a Consumption Graph. A consumption graph must be set up to show the total barrels of any given product for each terminal or storage location. A separate graph should not be prepared for each tank. Figure 1 is a consumption graph for motor gasoline during the month of October.

(1) Storage capacity for the product in thousands of barrels (vertical axis) is plotted against time in monthly intervals (horizontal axis). Days are figured from 0001 of one day to 0001 of the next. Figure 1 reflects a total capacity of 60,000 barrels (60M bbls).

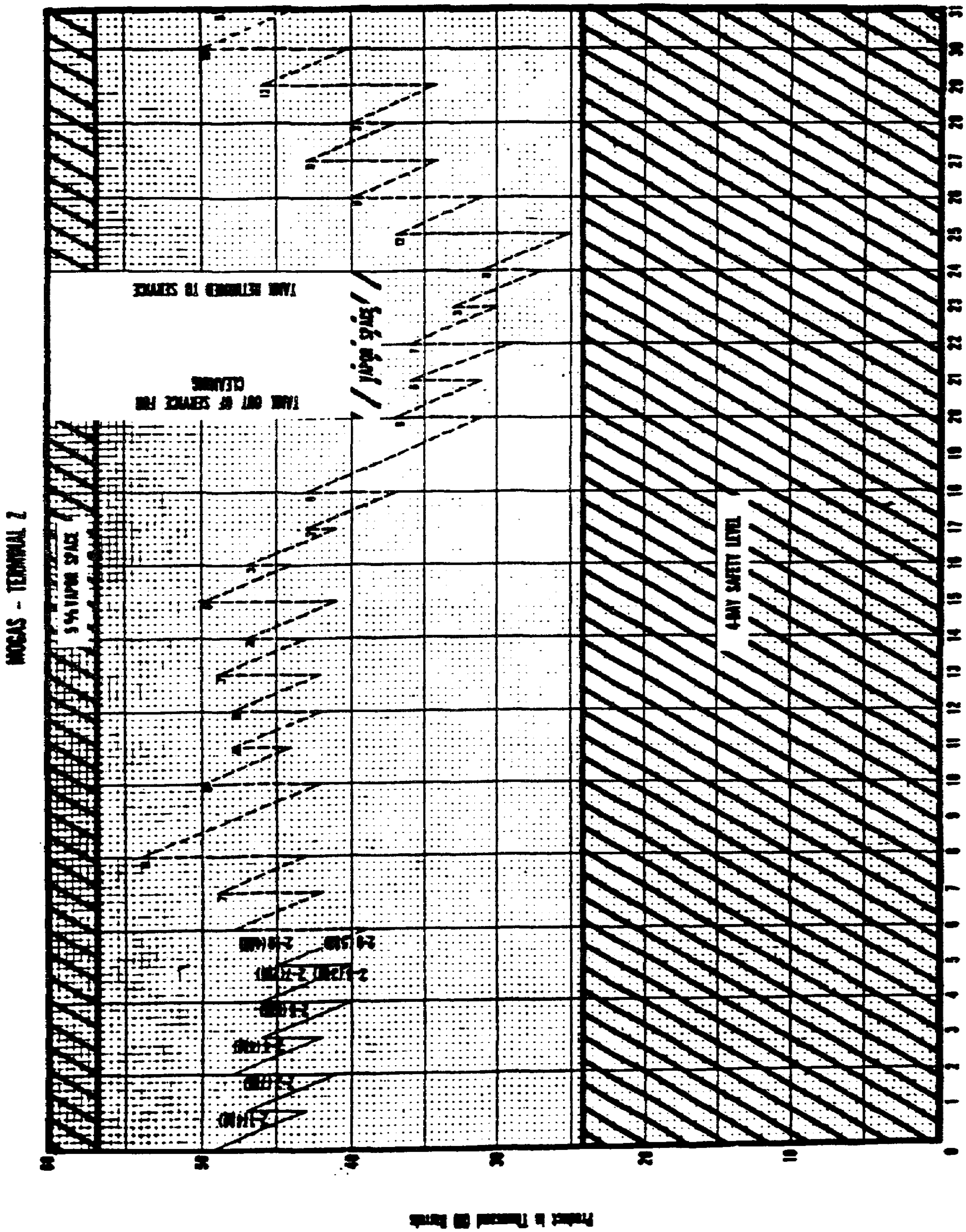

Figure 1. Consumption graph.

(2) Allowances for vapor space, 5 percent of total storage capacity, is shown at the top of the graph. Vapor space allows room for the fuel to expand and contract with temperature changes. For Terminal Z, with 60M bbls capacity, vapor space is figured as follows:

60,000 bbls (capacity) x 5% (vapor space)

= 60,000 x .05

= 3,000 bbls for vapor space

The 3,000 (3M) bbl vapor space is plotted down from the top of the graph. See figure 2 for a close-up.

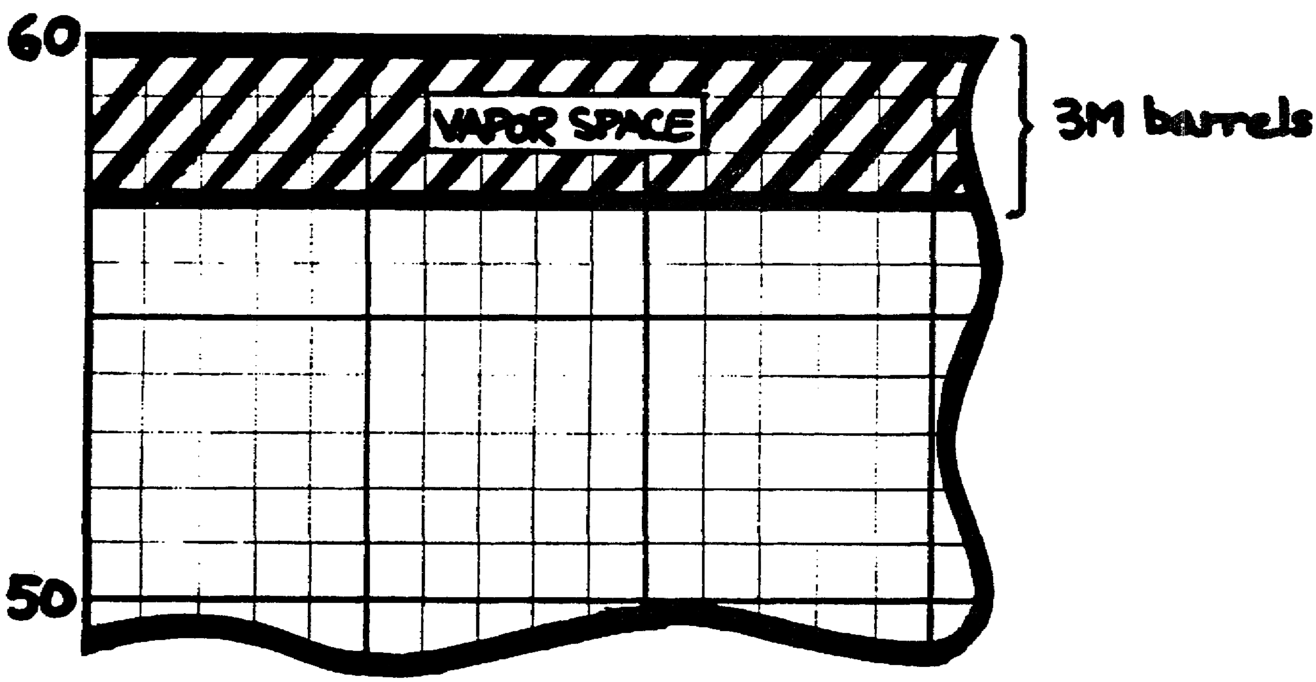

Figure 2. Plot for vapor space.

(3) Safety level, which is based on 4 days of normal (average) daily consumption, is shown at the bottom of the graph. The 4-day safety level is figured as follows:

4 (days supply) x 6,000 bbls

(Normal daily consumption from NOTE, figure 1)

= 4 x 6,000

= 24,000 (24M) bbls for 4-day safety level.

See figure 3 for a close-up.

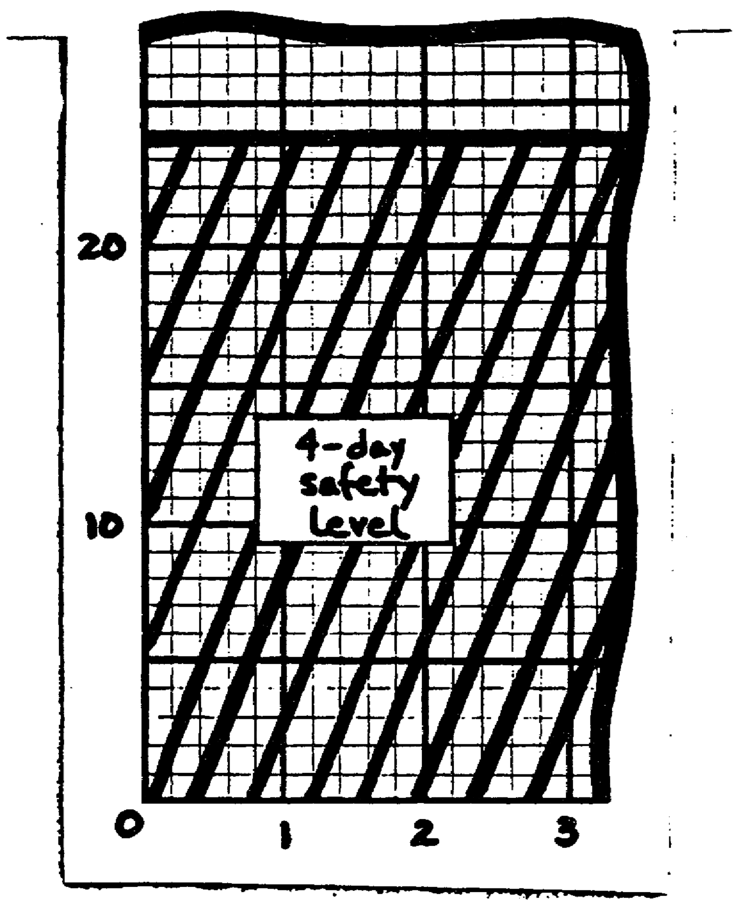

Figure 3. Plot for 4-day safety level.

(4) Calculated (projected) issues and receipts are shown by a broken line, and actual receipts and issues are shown by a solid line. In figure 4, the period began with 49M bbls in storage. The first day there was a total issue of 7M bbls and a total receipt of 5M bbls. The line shows a continuous drop in quantity from 49M bbls to 42M bbls (49M less the 7M issued). The line then reflects the 5M bbl gain by showing a sudden rise from 42M bbls to 47M bbls (42M on hand plus the 5M received). The second day shows 8M in issues and 9M in receipts. The third day shows projected issues of 6M bbls and projected receipts of 7M bbls. Projections for the next two days are also shown in figure 4.

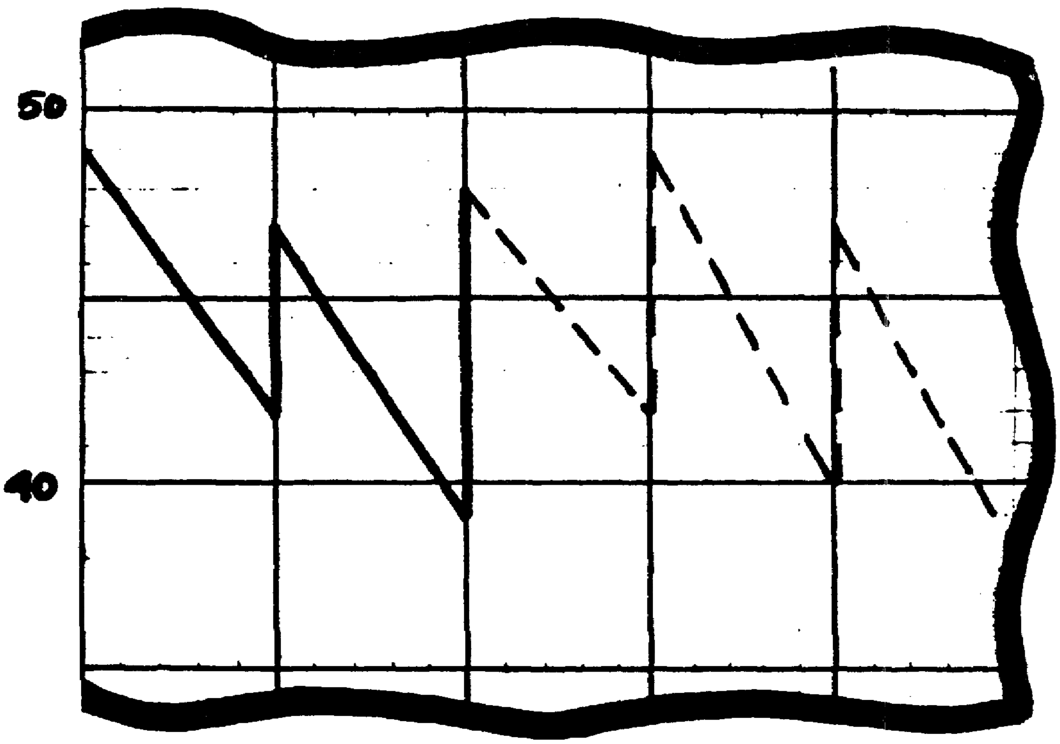

Figure 4. Actual and projected issues and receipts.

(5) Projected tank cleaning and repairs (reduced storage capacity) must be provided for; the reduced storage capacity is subtracted from the total capacity. In figure 1, a 20,000 barrel tank is shown scheduled for cleaning on 20 July. The total capacity of Terminal Z is reduced by 20M bbls. Notice also that the vapor space has been refigured. It is now 5 percent of 40M bbls, or 2M bbls.

(6) Differences in stock on hand from day to day indicate the rate of consumption. The average rate of consumption based on past experience must be projected to plan for future issues. The system must be replenished via pipeline, based on this projected consumption rate.

c. Batch Number. Figure 1 shows entries by each receipt such as 2-1 (4M), 2-2 (7M) and 2-4 (4M). These represent a batch number and the quantity of fuel in that batch. The batch number also identifies the type of product. A batch number must be assigned at the time each batch is put into the line. When product is put into a terminal, it loses its number; when it is taken out and moved farther up the line, it is assigned a new batch number. A batch number is made up of two parts, the product code number, and the numerical value of that batch. An example of such a number is 2-4.

(1) Product code. The first part of the number identifies the product (fuel). The suggested codes for the most common products are:

PRODUCT	CODE
AVGAS	1
MOGAS	2
JP-4	3
KEROSENE	4
DIESEL FUEL	5

In the example given (2-4), the number 2 identifies the product as automotive gasoline (MOGAS).

(2) Batch numerical value. The second part of the batch number identifies the number of batches of that particular product that have been pumped during that fiscal year. The numbers are assigned in sequence. Batch number 1 would be the first batch of that product pumped after 0001, 1 October. In the example given (2-4), this is the fourth batch of MOGAS pumped through the pipeline in that fiscal year.

(3) Additional information is included to tell personnel involved the quantity of product being pumped. The quantity is expressed in thousands of barrels (M). A batch number would then have this additional number added - for example 2-4 (4H). This would mean that the batch 2-4 was 4,000 barrels of MOGAS.

3. BATCHING SEQUENCES. Pipelines should, whenever practical, be used for one type and grade of product only; however, between bulk terminals, pipelines are often used as multiproduct lines. Problems that arise in pumping more than one product through a pipeline are (1) mixing of the products; (2) following the progress of the different products and the mixed portions (interfaces) so that the products can be taken off the line at the proper place; and (3) disposition of the interfaces.

a. Controlling the Size of Interfaces. All scheduling should be done in a sequence which will generate small, usable interfaces. The volume of the interface depends upon these factors: differences in gravity of adjacent products; pressure and velocity of the stream; interior conditions of the pipe; the number of pump stations; and the distance traveled by the interface. The size of the interface can be minimized by maintaining sufficient flow rate (velocity) in addition to introducing products into the pipeline in proper sequence (batching); and during shutdown, by maintaining a packed (pressurized) line. Sufficient positive pressure will tend to equalize small differences in gravity; thus the interface volume is kept to a minimum whether the interface stops on level ground or on a slope. A pipeline should never be shut down while an interface is in the line if it can be avoided because some increase in the volume of the interface will take place. The longer the pipeline is shut down, the larger the interface can become.

b. Determining Batching Sequence.

(1) To determine which product should be batched (pumped) behind another, you must consider not only the product demands, but also the API gravity of each product. Products should be injected into the pipeline in a sequence so that the new product has an API gravity as close as possible to that of the previous product. By following this procedure you will generate smaller, usable interfaces. Products likely to be batched in military multi-product pipelines include aviation gasoline (AVGAS), automotive gasoline (MOGAS), jet fuel (JP), kerosene (KERO), and diesel fuel (DF). Figure 5 shows the common API gravity ranges for these products.

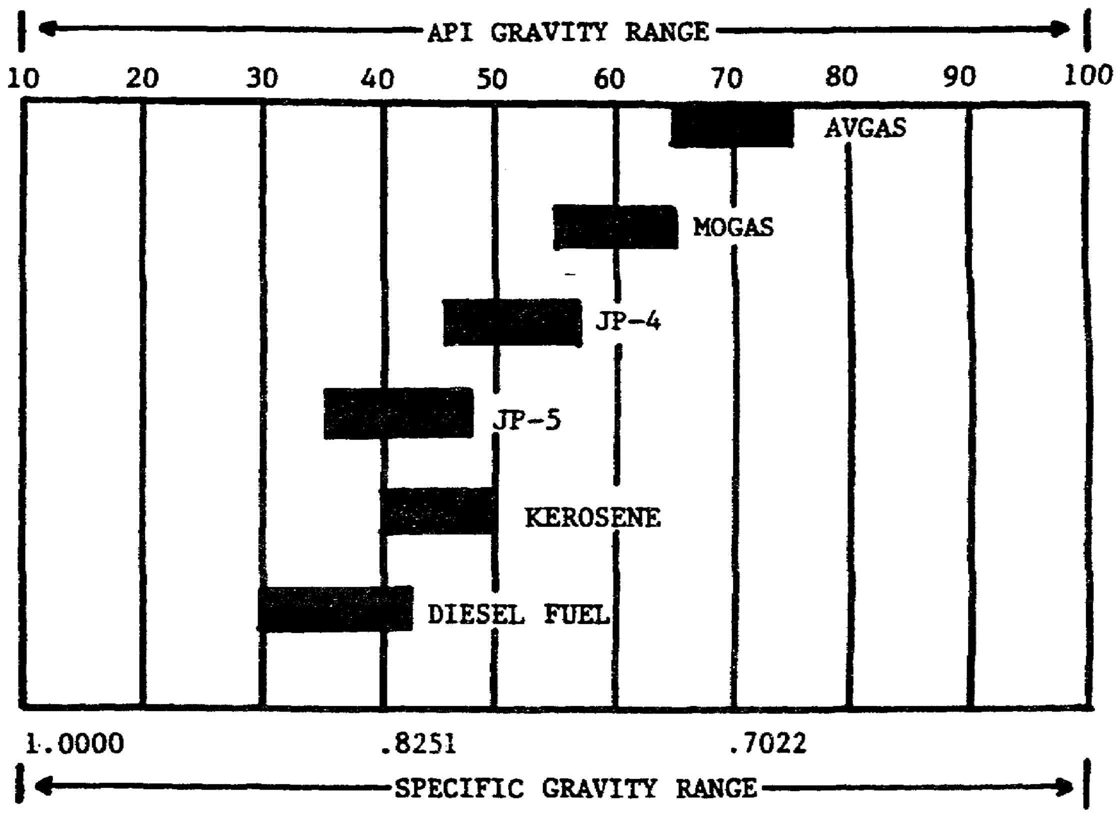

Figure 5. API gravity scale for petroleum products.

(2) Although products should be scheduled according to their API gravity, product demands do not always allow this. Products can be batched in any sequence but extreme care and extra precautions must be observed. Figure 6 describes which tank the interfaces should be cut into and when. The maximum percentage of interface product is also given. To insure that this maximum percentage is not exceeded, a careful record must be kept of interfaces to include the tank number and quantity of interface product injected into each tank. As a general rule, only one interface should be injected into any one tank of product prior to issue. The primary rule here is to schedule your batches (and interfaces) so that the percentages in figure 6 are never exceeded. After each receipt, your tanks should be sampled and laboratory analysis performed. The laboratory analysis results (and guidance from the petroleum laboratory NCO) should be checked before making any final decision on scheduling of batches (and interfaces).

TAIL PRODUCT	HEAD PRODUCT					
	115/145	MG	JP-4	JP-5	JP-8	D
115/145 AVGAS		Cut MG TK to 145 TK when first sample showing 100% 115/145 arrives at cutting point.	Cut from JP4 TK to 145 TK when first sample showing 100% 115/145 arrives at cutting point. (Max 115/145 permissible in JP-4 TK is 1.0%)	Cut from JP5 TK to slop TK when there is any indication of 115/145. Cut from slop TK to 145 TK when first sample shows 100% 115/145. (Permissible mixture of 115/145 into JP5 TK is none and vice versa.)	Cut from JP8 TK to slop TK when there is any indication of 115/145. Cut from slop TK to 145 TK when first sample shows 100% 115/145. (Permissible mixture of 115/145 into JP8 TK is none and vice versa.)	Cut from D TK to slop TK when first sample shows indication of 115/145. Cut from slop TK to 115/145 TK when sample shows 100% 115/145 (Permissible mixture of 115/145 into D is none and vice versa.)
MG MOTOR GASOLINE	Cut from 145 TK to MG TK when first sample shows indication of MG at cutting point.		Cut from JP4 TK to MG TK when sample contains 50% MG (Max MG in JP4 is 2.0%, max JP4 in MG is 1.0%.)	Cut from JP5 TK to slop TK when there is any indication of MG. Cut from slop TK to MG TK when first sample shows 50% MG. (Permissible mixture of MG into JP5 is none, max JP5 in MG is 1.0%.)	Cut from JP8 TK to slop TK when there is any indication of MG. Cut from slop TK to MG TK when first sample shows 50% MG. (Permissible mixture of MG into JP8 is none, max JP8 in MG is 1.0%.)	Cut from D TK to slop TK when sample shows first indication of MG. Cut from slop TK to MG TK when sample shows over 50% MG. (Max MG in D is none. Max D in MG is 0.5%.)
JP 4 FUEL	Cut from 145 TK into JP4 TK when first sample shows indication of JP4 at cutting point. (Max JP4 into 115/145 is none max 115/145 into JP4 is 1.0%.)	Cut from MG TK to JP4 TK when sample contains 50% JP4 (Max JP4 in MG is 1.0%, max MG into JP4 is 2.0%.)		Cut from JP5 TK to JP4 TK when there is any indication of JP4. (Permissible mixture of JP4 into JP5 is none, max JP5 into JP4 is 1.0%.)	Cut from JP8 TK to JP4 TK when there is any indication of JP4. Permissible mixture of JP4 into JP8 is none, max JP8 into JP4 is 1.0%.)	Cut from D TK to slop TK when first sample shows indication of JP4 at cutting point. Cut from slop TK to JP4 TK when sample shows 100% JP4. (Max D in JP4 is none and vice versa.)
JP 5 FUEL	Cut from 145 TK to slop TK when there is any indication of JP5. Cut from slop TK to JP5 TK when sample shows 100% JP5. (Permissible mixture of JP5 into 115/145 is none and vice versa.)	Cut from MG TK to slop TK when sample shows 50% of JP5. Cut from slop TK to JP5 TK when first sample shows 100% JP5. (Permissible mixture of JP5 into MG is 1.0%, none for MG into JP5.)	Cut from JP4 TK to JP5 TK when first sample indicates 100% JP5. (Permissible mixture of JP5 into JP4 is 1.0% max no mixture of JP4 into JP5 is permissible.)		Cut from JP8 to JP5 when first sample indicates 100% JP5. (permissible mixture of JP5 into JP8 is 1.0%. Max JP8 into JP5 is none.)	Cut from D TK into JP5 TK when first sample shows 100% JP5. (Permissible mixture of JP5 into D is 2.0%, Max D in JP5 is none.)
JP-8 FUEL	Cut from 145 TK to slop TK when there is an indication of JP8. Cut from slop TK to JP8 TK when sample shows 100% JP8. (Permissible mixture of JP8 into 115/145 is none and vice versa.)	Cut from MG TK to slop TK when sample shows 50% of JP8. Cut from slop TK to JP8 TK when first sample shows 100% JP8. (Permissible mixture of JP8 into MG is 2.0%, none for MG into JP8.)	Cut from JP4 TK to JP8 TK when first sample indicates 100% JP8. (Permissible mixture of JP8 into JP4 is 2.0% max no mixture of JP4 into JP8 is permissible.)	Cut from JP5 TK to JP8 TK when there is any indication of JP8. (Permissible mixture of JP8 into JP5 is none. max JP5 into JP8 is 1.0%.)		Cut from D TK into JP8 TK when first sample shows 100% JP8. (Permissible mixture of JP8 into D is 2.0%, Max D in JP8 is none.)
D DIESEL	Cut from 145 TK to slop TK when there is any indication of D. Cut from slop TK to D TK when sample shows 100% D. (Permissible mixture of D into 115/145 is none and vice versa.)	Cut from MG TK to slop TK when sample contains 50% or more of D. Cut from slop TK to D TK when sample shows 100% D. (Max D into MG is 0.5%, max MG into D is none.)	Cut from JP4 TK to slop TK when sample shows indication D at cutting point. Cut from slop TK to D TK when sample shows 100% D. (Max D into JP4 is none and vice versa.)	Cut from JP5 TK into slop TK when first sample shows indication of D. Cut from slop TK to D TK when sample shows over 50% D at cutting point. (Max D into JP5 is none, max JP5 into D is 2.0%.)	Cut from JP8 TK into slop TK when first sample shows indication of D. Cut from slop TK to D TK when sample shows over 50% D at cutting point. (Max D into JP8 is none, max JP8 into D is 2.0%.)	

Figure 6. Pipeline product segregation table.

(3) The lab NCOIC should provide operations with (1) the tank to accept the next interface and (2) the maximum amount of tail product in the interface that can be cut into the recommended tank. For example, the lab may recommend that a maximum of 75 barrels of tail product can be cut into the recommended tank. If the interface is 100 barrels long it would contain 50 barrels of head and 50 barrels of tail product. So cutting of the entire interface into the tank would be acceptable. The length (quantity) of the interface is determined by multiplying the flow rate by the length of time required for the interface to pass a given point. The flow rate can be determined from our pipeline schedule and the length of the interface (in minutes) is determined by having someone physically check the API gravity changes and record the times. An example would be product flowing at 1000 BPH and the time for the interface to pass is 15 seconds (15 seconds ÷ 60 seconds =.25 minute). Flow rate of 1000 BPH divided by 60 minutes equals 16.66 barrels or 700 gallons per minute (GPM)(16.66 barrels x 42 gallons per barrel). 700 GPM x .25 minutes equals 175 gallons in the interface.

(4) Since the condition of no two tanks is exactly the same, the schedule should normally have the interface going into a tank of high quality fuel. Figure 6 shows that a slop tank is used in many cases for receipt of the interface. In these cases if slop tanks are available, they should be used. If no slop tank is available, the principles outlined in 3b(2) and (3) above should be followed very closely. If the percentage of allowable interface is NONE, and no slop tank is available, you must either schedule a small quantity of another acceptable product between these two products or simply schedule the entire interface to be disposed of into a tank that can accept it. All scheduling must be done in such a way as to protect the quality of all products.

4. MONTHLY PIPELINE SCHEDULES.

a. General. The monthly pipeline schedule (fig 7) is based on requirements to maintain stock levels and shows programmed movements through the pipeline. When it is known what products are required for the 30-day period, a schedule can be prepared to determine the time it will take for the product to reach its destination after it has been started into the pipeline. This schedule is merely a graph which shows line capacity in barrels (distance) plotted against time in hours.

b. Preparation. The schedule is prepared on a sloping table top, which can be equipped with a full length parallel rule. It is desirable to use an adjustable protractor with the parallel rule to make sure that the flow rate scale is plotted correctly.

(1) The number of hours a line is to be pumped each day must be determined before the schedule is made. Time is shown from the beginning to the end of a given working day. The chart is drawn with the vertical axis representing the time period. Normally 1 inch on the vertical time axis represents 1 hour, and 24 major units represent a pipeline day (fig 7).

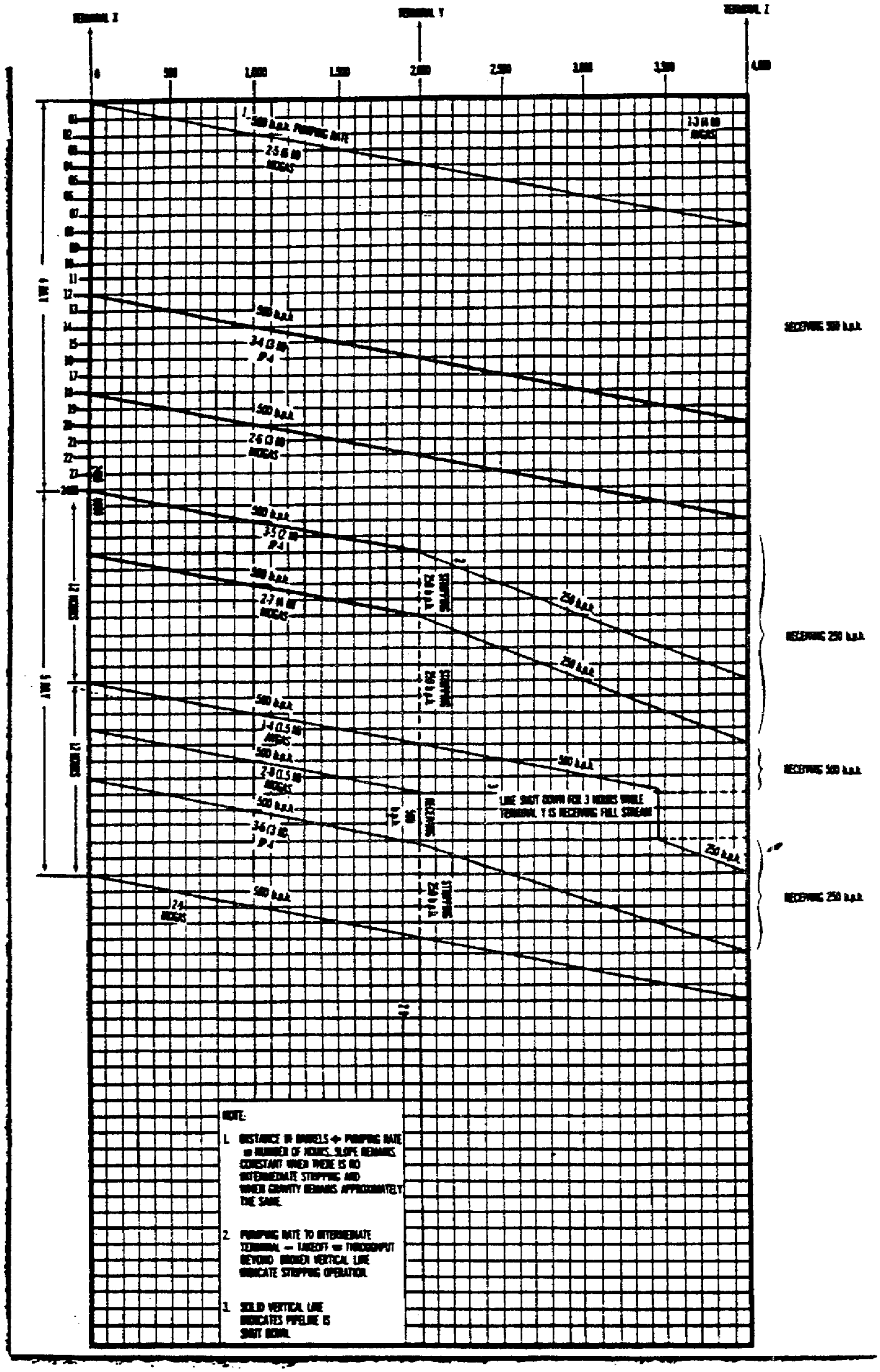

Figure 7. Monthly pipeline schedule.

(2) The horizontal axix is drawn to show linefill in distance in barrels. Normally, 1 inch on the horizontal axis represents 100 barrels (fig 7).

(3) Terminals are located by their respective linefill distance downstream from the base terminal and are plotted vertically.

(4) Each batch is labeled as to product and is identified by batch number. Each type of product is marked on the graph with a distinctive color. Suggested colors are as follows: AVGAS, blue; MOGAS, red; JP-4, green; kerosene, yellow; diesel, brown.

(5) The distance in barrels divided by the pumping rate equals the number of hours it will take for a given batch to reach a designated place (see NOTE 1, fig 7).

(6) The slope of the throughput lines remains constant when there is no intermediate stripping and when gravity remains approximately the same. An example of this is shown in figure 7. The batch designated 2-5 (6M) is shown being pumped from Terminal X to Terminal Z at a constant rate of 500 barrels per hour (BPH).

(7) Stripping of product at any intermediate terminal is indicated by changing the rate of flow. This is shown on the graph as a change in the angle of the throughput lines. Pumping rate to an intermediate terminal minus takeoff equals the throughput beyond.

(8) A broken vertical line indicates a stripping action (see NOTE 2, fig 7). In figure 7, batch 3-5 (2M) is being pumped from Terminal X at 500 BPH. At Terminal Y, 250 BPH is being stripped off. The remaining 250 BPH is being pumped on to Terminal Z.

(9) A broken horizontal line indicates that the pipeline is shut down.

(10) The points at which the sloping lines intersect the vertical lines representing terminals and stations indicate scheduled arrival times.

(11) When all of the throughput lines have been drawn, the graph represents all scheduled pumping and delivery operations for the month.

c. Example. Figure 7 shows an example of a 2-day portion of a monthly pipeline schedule. Although the monthly pipeline schedule is the master plan on which the daily pumping schedule, graphic progress chart, and daily pumping order are based, figure 7 may be explained by reading the daily pumping order for 5 July given in figure 8 and paragraph 5.

Date: 5 July (Continued from 4 July)

Time	Description	Terminal X In	Terminal X Out	Terminal Y In	Terminal Y Out	Terminal Z In	Terminal Z Out
0001	RE mogas FE JP-4		500				
0200	RE JP-4 FE mogas					500	
0400	RE JP-4 FE mogas		500				
	RE mogas FE JP-4			250			
0800	RE JP-4 FE mogas			250			
1200	RE mogas FE avgas		500				
	RE mogas FE JP-4					250	
1500	RE avgas FE mogas		500				
1600	RE JP-4 FE mogas					500	
	RE mogas FE avgas			Check time of passing			
1800	RE mogas FE JP-4		500				
1900	FE mogas RE avgas			500		Shut down	
2200	RE mogas FE JP-4			250		250	
2400	RE JP-4 FE mogas		500				
	RE mogas FE avgas					250	

(3,000 Bbls. JP-4)(1,500 Bbls. Mogas)(1,500 Bbls.)(4,000 Bbls. Mogas)(2,000 Bbls.)

(Avgas) (JP-4).

Notes: RE=Rear end
FE=Front end

Figure 8. Daily pumping schedule.

5. DAILY PUMPING SCHEDULE. Daily pumping schedules (fig 8) are prepared as a basis for dispatching the pipeline. They are a translation of the monthly schedule in abbreviated, tabular form for the days concerned and show changes and emergency requirements. They usually are prepared a week in advance so that the dispatching section can be equipped with a week's supply. They serve as a basis for the graphic progress chart, and, in turn, the daily pumping order.

6. COMPLETED GRAPHS AND SCHEDULES. When all the graphs and schedules are completed, they are forwarded to the operations sergeant for distribution and any additional required actions. Copies are kept on file to help with the estimated requirements as covered in paragraph 1.

REVIEW EXERCISE

The questions in this review exercise give you a chance to see how well you have learned the material in this lesson. The questions are based on the key points covered in the lesson.

Read each question and write your answer on the line or lines provided for it. If you do not know or are not sure what the answer is, check the paragraph reference that is shown in parentheses right after the item; then go back and study or read once again all of the referenced material and write your answer.

After you have answered all of the items, check your answers with the solution sheet at the end of this exercise. If you did not give the right answer to an item, erase it and write the correct solution. Then, as a final check, go back and restudy the lesson reference once more to make sure that your answer is the right one.

1. __________________ is the planning of future __________________ of products through a pipeline. (para 1)

2. A consumption graph provides the data needed to prepare __________________ and __________________ schedules. (para 2a)

3. ________________ ____________________ which is plotted on a consumption graph, allows for fuel to expand and contract. (para 2b(2))

4. What will the safety level be if the normal daily consumption is 4,300 barrels? __________________ (para 2b (3))

5. If a batch number is 3-17, you know it is the __________________ batch of __________________ this fiscal year. (para 2c(1)(2))

6. Scheduling should be done so that any __________________ are small and usable. (para 3a)

7. When determining batching sequence, you must consider product demand and __________________. (para 3b(1))

8. The quantity of an interface can be determined by multiplying the __________________ times the length of __________________ it takes the interface to pass a given point. (para 3b(3))

9. The __________________ __________________ __________________ shows programmed movements through the pipeline. (para 4a)

10. The daily pumping schedules are prepared as a basis for __________________ the pipeline. (para 5)

DO YOU UNDERSTAND EVERYTHING IN THIS REVIEW EXERCISE? HAVE YOU CHECKED YOUR RESPONSES, MADE CORRECTIONS, AND RESTUDIED THE TEXT, IF NECESSARY? IF YOU HAVE, GO ON TO THE EXAMINATION.

EXERCISE SOLUTIONS

EXERCISE	SOLUTION
1.	scheduling; movement
2.	monthly; daily
3.	vapor space
4.	17,200 bbls
5.	17th; JP-4
6.	interfaces
7.	API gravity
8.	flow rate; time
9.	monthly pipeline schedule
10.	dispatching