A TIME AND MOTION ANALYSIS OF CLEANING OPERATIONS IN MILK PLANTS

Thesis for the Degree of M. S.

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William E. Shiffermiller

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This is to certify that the

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"A TIME AND MOTION ANALYSIS OF CLEANING OPERATIONS IN MILK PLANTS"

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WILLIAM E. SHIFFERMILLER

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A TIME AND MOTION ANALYSIS OF CLEANING OPERATIONS IN MILK PLANTS

By

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A Thesis

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INTRODUCTION

History of the Cleaning Operation in the Milk Plant

Milk while being natures most nearly perfect food has the disadvantage of being a good media for the growth of bacteria. Some of these bacteria cause only spoilage of the product, but others are disease producing organisms capable of causing serious milk borne epidemics.

The use of milk as a food dates from the earlies recorded history, but the sanitary handling of milk is of comparative recent origin. The rise of the great urban centers of the world and particularly the urban growth of the United States after 1860 made the distribution of milk a complex problem.

The outbreak of several milk borne epidemics shortly before 1900 gave a great impetus to sanitary control of milk supplies. One of the earliest recorded efforts was by Dr. Henry Coit of Newark, New Jersey, who in 1894 formed the Essex County Medical Milk Commission which was the forerunner of the American Association of Medical Milk Commissions (1). The progress since that time has been rapid until today the quality control of milk supplies has reached a very high level. The number of milk borne epidemics has been reduced to almost none and the keeping quality of this perishable food has been greatly increased.

The methods used to clean the equipment in the early milk plants varied from conscientious attempts by the

better operators to do the best job possible with the limited cleaning methods and materials available, to outright filthy practices by the poorer operators.

Most of the improvement in plant sanitation has come about since 1920. The steady improvement of cleaning materials and detergents has made it possible to do a much better job of cleaning. Also the introduction of stainless steel in equipment construction made cleaning much easier.

In general, the method employed in cleaning milk plant equipment today is:

1. After use, flush lines and equipment with water.
2. Disassemble all lines and equipment.
3. Wash all milk contact surfaces using various solutions of commercial washing chemical compounds and various brushes, sponges, etc.
4. Rinse all lines and equipment with clean water.
5. Assemble equipment.
6. Sterilize by the use of hot water, steam, or chemical sterilizers.

Attitude of Public Health Officials

The public health official can well point with pride to his record in improving plant sanitation practices in milk plants. Today the milk plant is looked upon with envy by other branches of the food industry.

The attitude of the regulatory official as to the actual method of plant equipment cleaning varies somewhat from

area to area, but most milk ordinances state a fairly definite method of plant equipment clean up.

Due to limited personnel, it is impossible in actual practice for the health official to inspect the cleaning methods used in the milk plant very often. He must depend on periodic inspections and bacteriological analysis of the product to control sanitation practice.

In the past, sanitation programs have been plagued by political appointment of unqualified personnel without technical training. While this has been reduced very much in recent years, it is still all too prevalent.

The right thinking health official knows that a responsible milk plant operator is not going to jeopardize his investment by unsanitary practices. But the official must make his rules to cover the most unscrupulous operator.

The health official should be trained scientifically and be able to accept scientific data concerning plant equipment cleaning methods.

Attitude of the Milk Industry

The attitude of management toward the cleaning operations has varied from extreme interest in good plant sanitation and complete cooperation with health officials, to a few cases of slovenly practices and outright resistance to board of health regulations.

In general, management has not taken a very great interest in the methods of cleaning and have tended to accept

this expense as a necessary evil. Very few plants break their labor costs down far enough to include cleaning labor as a separate item, and those that do, accomplish it in a rather hit and miss manner. This is true of the large corporations as well as small plants.

The recent man power shortages of the war and post war periods has caused an upsurge in cleaning method investigation. Investigations are now under way or contemplated that may revolutionize the whole cleaning operation.

Attitude of the Milk Plant Worker

The cleaning operation in the milk plant is one of very great importance, yet in the past, the poorest type of workmen were usually given the job. Most dairy workmen do not consider the clean up job a very desirable one. Typical comments are: "It is a woman's work", "I get too wet", "I want to operate the equipment". There are some grounds for complaint from a health standpoint. The clean up man is constantly exposed to wet, damp conditions which can give rise to colds, rheumatism, etc.

Attitude of Equipment Manufacturers

The equipment manufacturer must satisfy both the regulatory official and the milk plant customer. Unlike many other lines of machinery, the dairy equipment engineer must first consider the sanitary aspects instead of the mechanical or other aspects.

For many reasons, some pieces of equipment require

large amounts of labor to disassemble, clean, and reassemble. The design of equipment is usually the result of a compromise between the factors of public health regulation and cost.

The equipment companies have constantly improved their equipment and milk plant equipment is generally considered the best in the food industry. The equipment engineer could undoubtedly design equipment that would be easier to clean if he did not have to compromise on so many other factors.

Attitude of Cleaning Compound Manufacturers

The cleaning compound manufacturers have constantly improved cleaning compounds. Every year they spend large amounts of money on research in trying to develop better cleaning compounds.

Much of their work has been on the compounds themselves rather than the actual method used in the plants, although they have contributed much in the latter field.

In general, their attitude has been one of service to the industry rather than just salesmen of cleaning compounds. They also must give considerable attention to regulatory officials wishes.

Explanation of Time and Motion Study

Time and motion study is the analysis of the methods, of the materials, and of the tools and equipment used, or

to be used in the performance of a piece of work. This analysis is carried on with the purpose of:

1. Finding the most economical way of doing the work.
2. Standardizing the methods, materials, tools and equipment.
3. Accurately determining the time required by a qualified person working at a normal pace to do the task.
4. Assisting in training the worker in the new method.(2)

In simpler terms, it is work simplification and is one of the tools used in the rapidly expanding field of methods engineering.

In the past there has been a tendency to separate time study from motion study, but in recent years this tendency has been reversed and they are now considered together as they supplement each other.

It is generally agreed that time study was originated by Frederick W. Taylor at the Midvale Steel Company in 1881. (3) The originators of motion study as we know it today were Frank B. Gilbreth and his wife Lillian M. Gilbreth. (4) The work of this great man and wife team is one of the most interesting in the field of science. Their life and work were the basis for the current best selling book, "Cheaper by the Dozen", and the motion picture of the same name. Mr. and Mrs. Gilbreth broke down operations performed by man into fundamental motions of the two hands which they called Therbligs. By the use of these tools they sought to simplify operations in many fields.

In the general use of time and motion study, the operation is broken down into its simplest elements or steps. The steps are then put on a devise known as a process chart which is a graphical representation of each step needed to complete the operation. A flow diagram is then made which traces the path of the operator, material, or object through the plant. This is usually followed by an activity chart which is a breakdown of the operation plotted against a time scale. After all this is completed the data are analyzed in an effort to find a better method. Each step is subjected to rigid questioning to find if it is necessary, if it can be combined with other steps, or be replaced by a better step.

When the operation has been improved, it is then taught to the operator. After the operator has become proficient in the new method, a time study is made. The operation is broken down into elements or steps and a stop watch reading is taken of each step. Enough readings are taken to assure a representative sample, usually around ten for each element. The performance is then rated, which is that part of a time study in which the person taking the study rates the operator with his own idea of a normal performance. The normal performance is usually taken as 100 per cent.

The rating given the operator is then multiplied by the average time of each step. This time will then equate all operators both fast and slow. All of the individual

times of each step are then added up to give the total time for the whole operation. To this is added an arbitrary amount to take care of allowances for rest, personal needs, or unusual working conditions. The result is the standard time for the operation.

This time is then used as a basis for establishing piece work rates, setting a fair days work, predicting man power requirements, and predetermining cost of finished product.

The mass production industries have made the most use of time and motion study. Most of these industries have methods engineering departments who search constantly for better methods using time and motion study as a tool.

Most of the operations in these industries are of the repetitive type which is a short sequence of operations repeated at frequent intervals. This type of operation lends itself very well to time and motion analysis, and most time and motion work in the past has been on these operations. In recent years time and motion study has been expanded to include some nonrepetitive operations such as maintenance work, janitor clean up, and work operations occuring at infrequent intervals.

One of the most interesting chapters in the growth of the great automobile industry is the use of time and motion studies in their never ending search for better methods.

REVIEW OF THE LITERATURE

The use of time and motion study in milk plant operation is so new that very little reference to it can be found in the literature. Reference to specific applications to the cleaning operation cannot be found.

Therefore most of the references cited have been taken from other industries that have more or less similar operations. The milk industry has always tried to practice some work simplification, although it was never given exactly this methods engineering nomenclature. Considerable amounts of literature on the cleaning operation in milk plants are available, but most of this is on the compounds rather than the methods.

Time and Motion Study Applications in Allied Industries

That time and motion analysis can be applied to non-repetitive operations was demonstrated by Sadoff (29) who made time and motion studies of all the clean up and maintenance operations at the large Swift and Company meat packing plant in Chicago. Six senior time study men devoted three full years to this study. They were able to simplify the operations and establish standard times for each operation.

Gobb (15) also established standard times for truckers and sweepers and put these men on an incentive pay plan which reduced the man power required from 19 to 11 men.

Emmons (11) applied time and motion analysis to the janitors in a factory building, and was able to establish a schedule of operations that resulted in large savings.

In his work with time and motion applications to job order shops, Tidball (32) proved the fallacy in the statement that it was impossible to have standard times for special order shops.

The continuous flow processes of the chemical industries have much in common with milk plant operation. Von Pechmann (34) and Rossmoore and Aries (26) applied time and motion analysis to these industries with great success. They report savings in time up to 34% on some operations.

In the liquor distilleries, large amounts of time are spent in bottling and clean up operations much like milk plant operations. Vlissinger (33) applied time and motion studies to these operations and reports savings as high as 33%.

All operations in the food industry have much in common. The use of time and motion studies in food plants other than dairy plants has become quite common in recent years. Engel (12) reports some very interesting savings made in an English walnut food factory. Nadler (20) applied time and motion study to canning plant operations with a great deal of success. He lists some of the results of these studies:

1. Improved schedules.
2. Predetermination of job requirements.

3. Checks on worker efficiency.

4. Determination of best methods.

Mundel (19) has devoted a large amount of time to applications of time and motion study to farm operations such as doing farm chores. These operations in the past have taken a large amount of the farmers time. In some cases Mundel was able to reduce the time required by 50%. Another interesting time and motion application by Mundel was on the hand peeling of tomatoes in a canning factory. By the use of micromotion camera studies, he was able to effect large savings on this operation (18).

That time and motion study has many uses other than rate setting was brought out by Stearns (28) when he explained the plant managers use of time and motion study by controlling schedules, man power requirements, and method of operation.

Teranes (31) made a study of the walking required in a factory packing department. By the use of time and motion analysis he was able to reduce the walking required per man in an 8-hour day from 12,000 feet to 1800 feet, with a resulting saving in labor of over 30%.

Specific Time and Motion Applications in the Dairy Industry

Probably the most extensive use of time and motion study in the dairy industry has been made by the H. P. Hood and Sons Company. This dairy firm has established a full time methods engineering and work simplification

department. This department has been in operation 8 years, and during this time, they have been able by the use of time and motion analysis to reduce their operation time considerably (10). Dunlop (9) explains his method of training personnel in work simplification by the use of company schools. At present, this company is making a work simplification study of the cleaning operation in their plants.

Pelling (24) reports the use of time and motion analysis applied to wrapping cheese in an Australian cheese factory. He was able to save 2500 dollars yearly by an improved method. Morrow (17) applied time and motion study to the retail delivery of milk with good results.

The use of time and motion study in a British milk bottling plant is discussed by Proctor (23) in a paper presented at the 1949 Worlds Dairy Congress.

Cases of Work Simplification in Dairy Cleaning

Perry and co-workers (22) have developed several cleaning aids which show considerable promise in reducing cleaning costs. He lists the following aids:

1. The Hot Water Generator. - This machine eliminates the suction tee and delivers water at a temperature of 115 degrees F. to special hose stations. These hose stations are strategically located about the plant. The water supply is controlled by shut off valves located at the end of the hose.

2. Sanitary Pipe Cleaner. - This machine by the use of solution fed revolving brushes, and a novel rinsing arrangement enables a sanitary pipe to be cleaned inside and out, and rinsed in a continuous arm motion.
3. Sanitary Fitting Cleaner. - This machine utilizes a tank equipped with solution fed revolving brushes, both inside and outside. A continuous stream of water from a tap enables quick rinsing.
4. Separator Disc Cleaner. - This machine uses solution fed revolving brushes that cleans the inside and outside of the disc at the same time.
5. Solution Fed Hand Brushes. - These are brushes in which the solution is pumped through the handle into the brushes while cleaning.
6. Central Cleaning Solution Tank - This utilizes a central tank in which all general cleaning solutions are mixed and then piped to various outlets in the plant.
7. Spray Sterilizing Unit. - This machine forces the sterilizing solution by air pressure through a hose and jet nozzle. It is used for spraying vats, storage tanks, etc.

A recent development in the cleaning of cold milk storage tanks is the use of pump fed revolving jets. This machine consists of a solution tank, pump, pipe and jets. The jets which revolve in a horizontal and vertical plane

are placed in the center of the tank, and the cleaning solution is circulated through the jets until the tank is clean. Good results were reported by the plant operator and these results were checked by board of health officials. This method was tried on hot milk tanks with less success but more experimental work is contemplated on this phase (30).

Samuelson (27) found the use of the steam jet utilizing the Venturi principle with a cleaning solution was effective and economical in cleaning equipment exteriors, conveyors, floors, and bottle capping machines.

Myrick (16) states that from 20 to 25 per cent of the total plant labor cost is involved in the cleaning operation. This is in agreement with Robinson's estimate of 30 per cent (25). Myrick also suggests that brushes are an important factor in labor saving in the cleaning operation. He recommends that the brush should be designed especially for each cleaning operation, with emphasis placed on the size, shape, and kind of bristles.

Fowler (14) found that the cleaning operation was the most neglected job in the dairy, given for the most part to the poorest worker. He suggests that the cleaning operation should be a carefully planned operation with each piece of equipment cleaned in a standard manner.

The function of plant design in the cleaning operation is brought out by Burnett in his explanation of the operation of the new Producers Creamery Company plant at Lebanon,

Missouri. This plant has been designed for sanitation with equipment layout and cleaning operations planned in detail. This plant uses a great deal of glass pipe which is cleaned in place by circulatory methods (5).

For a number of years the dairy plants in Europe have been using circulatory methods for cleaning dairy equipment without disassembly. In general, the sanitary standards in Europe are lower than in the United States, but it may be to our advantage to make a thorough investigation of this great labor saving method.

Fisker (13) and Postumus (21) in papers presented at the 1949 Worlds Dairy Congress explain systems used to clean by circulatory methods a milk pasteurizing plant completely assembled. The general method is as follows:

1. Flush system with cold water.
2. Circulate with alkali cleaning solution.
3. Flush with cold water.
4. Circulate with acid cleaning solution.
5. Flush with water.
6. Circulate chlorine solution and leave solution in system until next operation.

STATEMENT OF THE PROBLEM

A Time and Motion Analysis of the Cleaning Operations in Milk Plants.

Importance of the Problem

The equipment in the milk plant consists of some 14 to 20 pieces of machinery. All of this equipment is made of stainless steel, tinned copper, or some alloy suitable for milk handling. This equipment is connected by sanitary milk pipe in lengths varying from 10 feet down to 3 inches. In these lines are tees, ells, and valves. The amount of pipe varies from about 100 linear feet in small plants to as high as 10,000 linear feet in large plants.

Every piece of equipment and all the sanitary lines are completely disassembled, washed, reassembled and then sterilized every day, 365 days per year. This is a very time consuming and expensive operation as well as a disagreeable task from the workers standpoint.

Objectives

To determine the elemental motions involved in the cleaning operations in three commercial milk plants, and to find the average time required for a normal worker to perform these elemental motions. To study the resulting motions and elemental times for the purpose of:

1. Eliminating unnecessary motions.

2. Simplify necessary motions.
3. Determine the individual parts of pieces of machinery that require the most time to clean.
4. Determine the percentage of total labor cost represented by the cleaning operations.
5. Make comparisons between the three dairies when practical.
6. Break down the operations into major group units and analyze these units.

All of the suggested simplifications to be based on known practices, and equipment available at the present time.

PROCEDURE

Three commercial dairies were selected according to representative size. Dairy "A" received 20,000 pounds of milk daily, dairy "B" 40,000 pounds, dairy "C" 100,000 pounds. A great deal of credit must be given the management of these companies for granting permission to make such a study so unusual to the dairy industry. The first thoughts of a dairy worker on having a stop watch check his work is that the manager is checking on him and is dissatisfied with his production. It was necessary to use a great amount of diplomacy and sell the men on the purposes of the study. By proceeding on this basis, the entire study was completed without incident and in a spirit of mutual good will. In the mass production industries, this problem would not present itself as their workers are familiar with the use and functions of time and motion study. Dairy "B" was a union plant, while dairies "A" and "C" were non-union.

This type of study falls into the nonrepetitive class, and it is one of the hardest of this class to which to apply time and motion analysis. The ordinary time and motion study is made on short cycle operations of a few elements or steps repeated many times per day. The cleaning operation in a milk plant is performed only once daily. The various cleaning operations are performed at any time in the 24-hour day, and the number of elements

or steps can run as high as 100 on some pieces of equipment.

In an ordinary time and motion application, a motion and work simplification study is made first. Then the worker is trained in the better method after which a time study is made of the new method for rate setting purposes. In this study it was impossible to instruct the worker, nor was it desired, as the motions and time desired were as exist today in representative commercial milk plants.

The procedure followed was to make repeated observations of the cleaning operation of each piece of equipment. Each operation was broken down into elements or steps that were convenient to time. When it was reasonably certain that each step of a particular operation was followed by the worker without change, a time study of the operation was made.

The watch used was a decimal minute watch with one sweep of the hand divided into one hundred parts of one hundredth of a minute each. All time recorded was in unit minutes and hundredths of a minute.

The method of timing used was the "snap back method". This method is open to some criticism in that some small amount of time is lost in the snapping of the hand back to zero at the end of each element, even though the watch automatically starts again. Most of the criticism of this system occurs when it is used for rate setting. In

this study, rate setting was not involved and due to the uninstructed worker not always following the elements in numerical order, this method was much easier to apply. Carroll states (6) "While observing a long series of very fast elements, the continuous method is invaluable. For practically all other studies, the snap back method is much preferred. The snap back method includes a small error in each reading. This is inconsequential in comparison with the probable errors in human judgment included when rating the performance."

The elements of each operation was recorded on the regular time study sheets used by the Industrial Engineering Section of the Mechanical Engineering Department at Michigan State College. These sheets were not exactly suited to this type of study, but they were already printed and it seemed advisable to take advantage of this.

In most cases ten elemental time values were taken for each step. This required a great amount of time, both in the observation of the worker as to his motions, and the recording of the time for ten complete cycles. The ten elemental times were then averaged arithmetically and the actual time for each element found.

The most important problem of the study was then encountered in the question of how to rate the performance, and apply allowances. This will be the most difficult part for the dairy layman to understand. In all industrial

applications of time study, it is desired to find the time required for an average worker to perform a given task. For this reason, the performance is rated as to the effort of the particular worker. Workers vary a great deal in their speed of performance, this range usually being from one third of normal performance to twice normal performance (7).

In this study it was also desirable to arrive at the time required for the average worker to perform the task. All the operators were rated on a basis of 100% for an average operation.

Another interesting aspect of the rating of this study is the question of the cleanliness of the equipment after the performance. Certainly, the time required to perform a cleaning operation is a function of the cleanliness of the equipment after cleaning. In the rating of the worker as to speed and efficiency, the writer leaned heavily on his more than a decade of practical experience as a dairy worker and plant superintendent.

In this study, it was assumed that the equipment was cleaned satisfactorily after the performance of the task. In cases where there was reason to doubt this, the entire cycle time was discarded. Also, during the entire time of this study, the products of these dairies were under rigid board of health bacteriological analysis, and all of the products were within legal limits. This position

seemed tenable, because of the fact that it was desired to find the time required in the cleaning operation as it exists today in commercial plants.

The rating of the performance makes it possible to arrive at elemental and cycle times that, with some degree of accuracy, would be applicable to all milk plants.

Allowances are then combined with the rating and applied to each actual element time. The concept of allowances is one that may come as a surprise to some dairy managers. Many of these managers like to believe that they get close to sixty minutes work per hour out of each plant worker, but such is far from the actual case. Allowances must be made for personal needs, such as going to the toilet, getting a drink, etc. Additional allowances must be made for fatigue and avoidable and unavoidable delays.

The value of these allowances depends very much on the type of work involved. In some types of work such as blast furnace work in steel mills, this may run as high as 50%, while in light work, under good conditions, it could be as low as 5%. Most shop operations fit in a class for which 20% is normal allowance (8).

The figures that were used in this study were 5% for personal needs, 10% for fatigue allowances, and 5% for delay allowance, making a total allowance of 20%. This seemed to be a reasonable allowance for this type of work

which is not of the worst type, but nevertheless is not of the best, because of hot, wet conditions. This would be in line with the over-all shop average, and from the writer's own experience this is about as it exists in commercial plants.

Most of the pieces of equipment was relatively easy to break down into timeable elements although some of the equipment required a large number of elements which were completed at different times in the day. The most difficult operation to break down was the disassembly, cleaning and reassembly of the sanitary pipe. This required a great deal of thought in order to keep from having merely a total time, which would not explain very well where the time was involved.

The system decided upon was to divide the pipe into representative lengths of 6" to 2', 2' to 4', 4' to 7', and 7' to 10'. By taking enough time trials of each length division, it was possible to arrive at a fairly accurate figure. The disassembly and assembly were broken down into elements. The carrying of the pipe to and from the wash tanks was based on actual trips made without regard to pipe length.

After all the equipment in all three milk plants was timed, it was then recorded in the final form and analyzed.

IE-4 | ALSO APPLIES TO: PART NO. | PART NO.

PLANT: DAIRY "B"

MICHIGAN STATE COLLEGE — MECHANICAL ENGINEERING DEPARTMENT

TIME STUDY OBSERVATION SHEET

PART NO. | REG. NO. | OPER. NO. | DATE EFFECTIVE

PART NAME: 2000 GALLON UPRIGHT MILK STORAGE TANK | OPERATION NAME | MODEL | DEPT. & GROUP

EL. NO.	ELEMENT DESCRIPTION			ELEMENTAL TIME 1	2	3	4	5	6	7	8	9	10	AVERAGE	RATING	ALLOWED TIME IN MIN.
1.	Open Manhole.		C	.30	.37	.29	.41	.36	.38	.31	.33	.29	.33	.337	120%	.404
2.	Walk 20 ft., turn on water in hose, return to vat with hose.		C	.40	.38	.49	.43	.45	.36	.39	.43	.48	.44	.425	"	.510
3.	Rinse Tank.		C	2.40	3.10	2.63	2.39	2.56	2.48	2.33	2.48	2.39	2.46	2.522	"	3.026
4.	Walk 50 ft., get bucket of cleaning solution and return to tank.		C	.85	.93	.87	.75	1.03	.98	.91	.84	.79	.88	.882	"	1.058
5.	Climb into tank with bucket and brush.		C	.60	.73	.65	.58	.67	.69	.71	.68	.59	.63	.653	"	.783
6.	Wash Tank.		C	3.40	4.10	3.01	3.91	3.46	4.10	3.87	3.45	3.81	4.01	3.712	"	4.454
7.	Climb out of tank.		C	.30	.33	.31	.29	.38	X	.31	.33	.40	.38	.341	"	.409
8.	Wash manhole cover.		C	1.30	1.29	1.35	1.43	1.31	1.19	1.23	1.39	1.36	1.28	1.310	"	1.572
9.	Rinse Tank.		C	1.20	1.35	1.33	1.25	1.18	1.17	1.24	X	1.34	1.36	1.266	"	1.519
10.	Walk 20 ft., return hose, turn off water, return to tank.		C	.37	.39	.45	.36	.33	.44	.37	.41	.43	.32	.387	"	.464
11.	Close manhole.		C	.51	.47	.63	.45	.57	.51	.56	.63	X	.53	.536	"	.643
			C													
			C													
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			C													

OBSERVED DATE | FROM A.M. P.M. TO A.M. P.M. | FORMER REG. NO.

OBSERVED BY | CHECKER'S O.K. | FORMER STD. TIME

T.S. SUPER | T.S. REQUESTED BY | FORMER PROD. HR.

FOREMAN'S O.K. DATE

SUP'TS. O.K. DATE

REASON FOR STUDY

OPERATOR'S NAME & NO. Herb | BASE RATE $ | PIECE RATE $

ALLOWANCE CALCULATION

Performance Rating 100%

Allowances 20%

POSSIBLE PROD. PER HR.

ALLOWED CYCLE TIME PER PC. 14.840

= TOOL ALLOWANCE IN MIN. PER PC.

= OTHER ALLOWANCES IN MIN. PER PC.

SUB-TOTAL

= PERSONAL ALLOWANCE IN MIN. PER PC.

STANDARD MINUTES PER PC.

STANDARD HOURS PER PC.

AVE. PRODUCTION PER HOUR

Figure 1 - Time Study Observation Sheet

RESULTS

The description of the motions involved, and the time required for each step in the cleaning operations can be found in the appendices. Appendix "A" applies to Dairy "A", Appendix "B" to Dairy "B", and Appendix "C" to Dairy "C". A complete time study observation sheet as an example is given in Figure 1.

Type of Operation and Equipment - Dairy "A"

This dairy is typical of small fluid milk plants. The products handled include bottled milk and cream, chocolate milk, butter milk, and cottage cheese. The milk is received in 10 gallon cans from the producer pick up trucks and it is processed in the regular manner. From the filler, the cases are handled by case trucks to the refrigerator, and are loaded on the route trucks in the same manner.

Receiving Equipment - The receiving equipment consists of a two compartment weigh tank suspended over a surge tank. The equipment is placed in a space cut in the wall, with dumping on one side of the wall and the milk pumped away on the other side.

Milk Filter - The filter is of the plate type, with the filter cloth held between two plates.

Separator and Clarifier - Both the separator and the clarifier use the same frame and driving mechanism. The

interchange of bowl parts makes it possible to change from separating to clarifying. Each has a capacity of 3500 pounds per hour.

Pasteurizing Equipment - This equipment consists of two 200 gallon round glass lined vats, and one 200 gallon stainless steel vat. Each of these vats have an enamel outside lining. In addition, a small 100 gallon square spray vat is used for special products. The butter milk vat is a 60 gallon round glass lined vat with a vertical coil.

Milk Cooling Equipment - The pasteurized milk is cooled over a multiple section surface cooler of the cabinet type. This cooler is of an older type and the brine and water headers must be removed for cleaning. The cooler is composed of 5 sections. The cream is cooled over a small single section surface cooler.

Homogenizer - The homogenizer is of the single stage type with a capacity of 500 gallons per hour.

Bottle Filler - The bottle filler is a 10 valve filler with 4 capping heads of the rotary type.

Milk Storage Equipment - This equipment consists of one 500 gallon horizontal cylinder type tank with a surface cooling section inside.

Milk Pumps - Two centrifugal milk pumps and one positive displacement pump are used.

Sanitary Pipe and Fittings - The pipe and fittings

are of the 1½" size, with a few 1" pieces.

Cleaning Equipment - The cleaning equipment consists of one wash tank 11' x 1' x 1' with pipe rack attached, and assorted brushes and sponges.

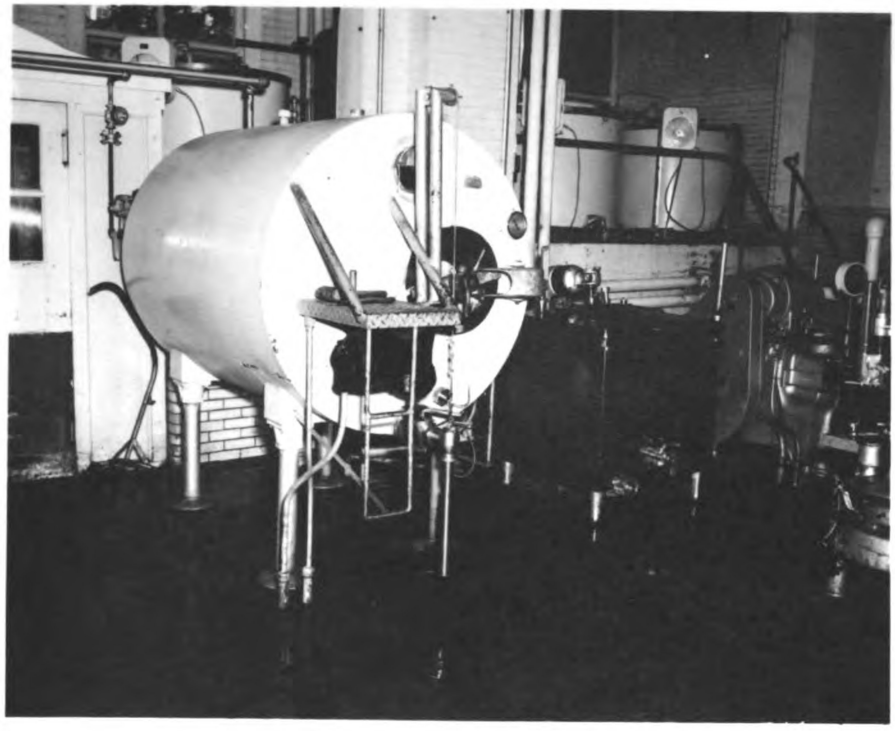

Figure 2 - Dairy "A" 500 Gallon Milk Storage Tank and 100 Gallon Square Spray Vat

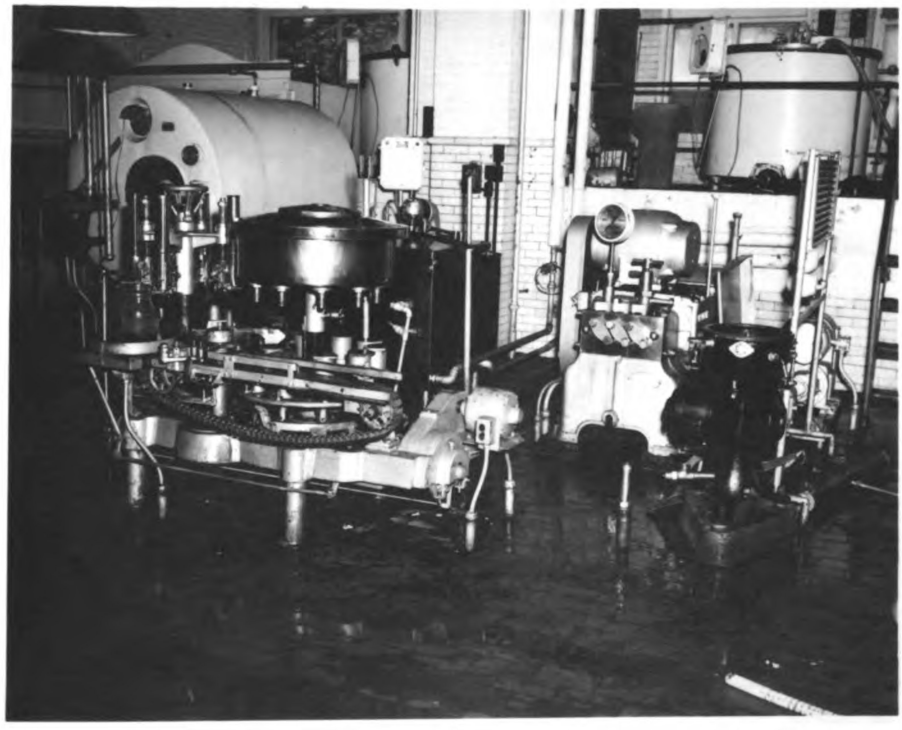

Figure 3 - Dairy "A" Bottle Filler and Homogenizer

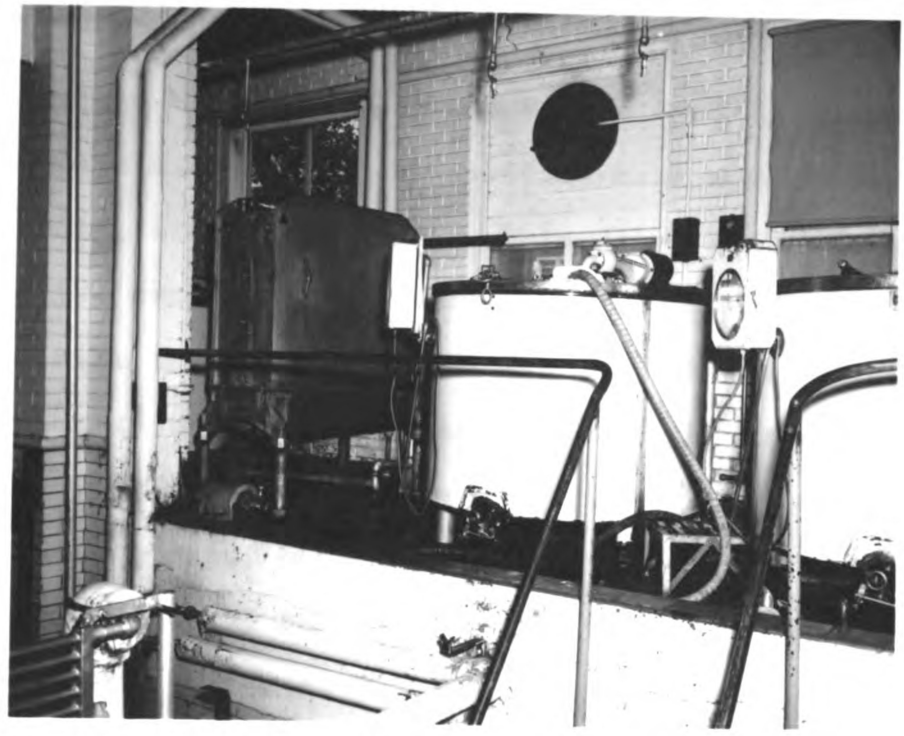

Figure 4 - Dairy "A" 200 Gallon Vats and Cabinet Milk Cooler

Figure 5 - Dairy "A" Separator-Clarifier, Cream Cooler, Milk Filter, and Wall Opening Where Weigh Tank is Located

Type of Operation and Equipment - Dairy "B"

This is a medium size dairy with a typical operation. The products handled include bottled milk and cream, chocolate milk, and butter milk. This dairy did not manufacture its own cottage cheese.

The milk is received in 10 gallon milk cans from producer pick up trucks. The cans are brought into the plant and returned to the truck by power driven chain conveyers. A paper bottle machine was installed but not in operation at the time this study was made.

Receiving Equipment - The weigh tank is of the suspended one compartment type with a surge tank below.

Milk Storage Equipment - The milk storage equipment consists of two 1000 gallon square storage tanks with surface cooling coils inside, and one upright 2000 gallon cold wall storage tank.

Clarifier - The clarifier has a capacity of 10,000 pounds per hour.

Separator - The separator is not of the air tight type and has a capacity of 5500 pounds per hour.

Homogenizer - The homogenizer has a capacity of 500 gallons per hour.

Preheater - The preheater is of the tubular type consisting of three large tubes each containing 12 milk tubes.

Pasteurizing Equipment - The pasteurizing equipment consists of five 200 gallon rectangular spray vats, one

200 gallon round vat for butter milk, and one 100 gallon round vat for cream.

Bottle Filler - The filler is of the vacuum type with 16 filling valves and six capping heads.

Milk Pumps - The milk pumped by 3 centrifugal pumps and 1 positive displacement type pump.

Milk Cooling Equipment - The milk cooling equipment consists of 2 multiple section cabinet type coolers, 1 with 6 sections 5' x 4', and the other with 3 sections 5' x 5'.

Sanitary Pipe and Fittings - The pipe and fittings are all $1\frac{1}{2}$".

Cleaning Equipment - The cleaning equipment consists of two 11' x 1' x 1' wash tanks, one 4' x 2' x 2' wash tank, and one power driven brush for disc cleaning, and assorted brushes and sponges.

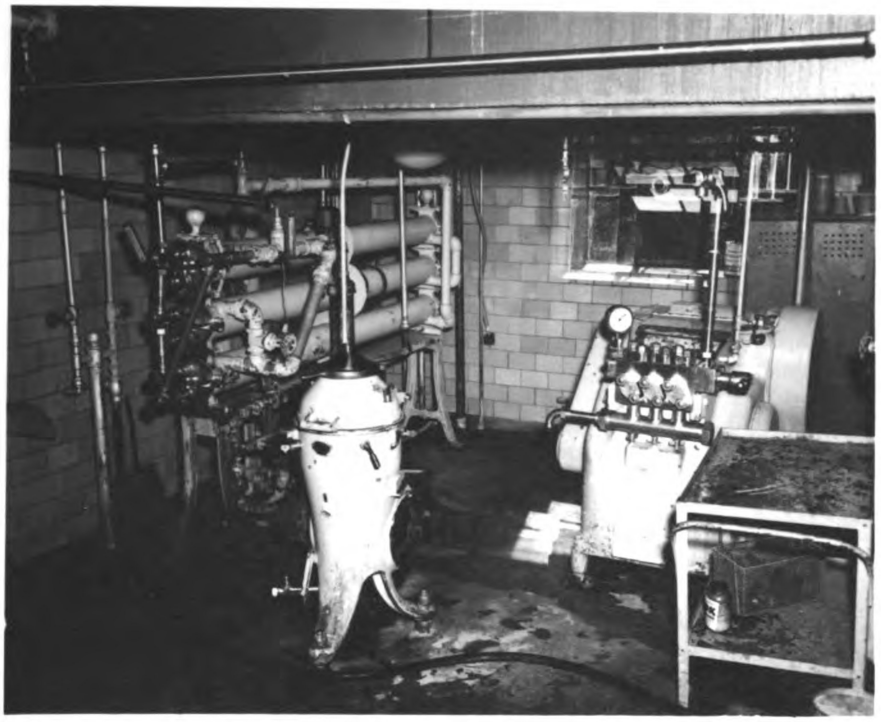

Figure 6 - Dairy "B" Clarifier, Homogenizer, and Preheater

Figure 7 - Dairy "B" Bottle Filler

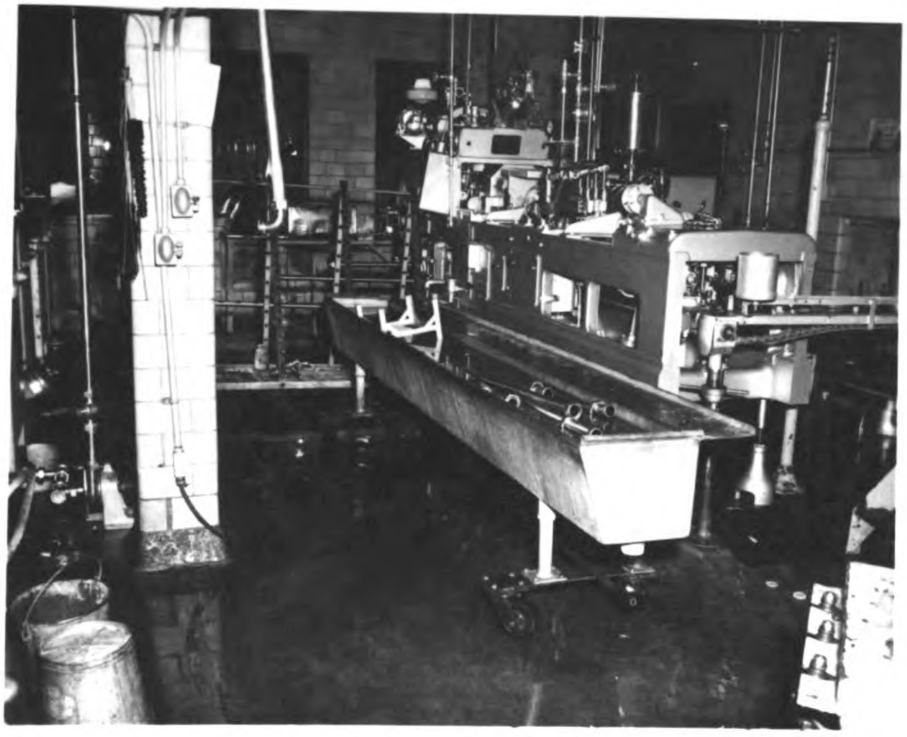

Figure 8 - Dairy "B" Wash Tank and Pipe Rack. Paper Bottle Machine was Installed but not Operated

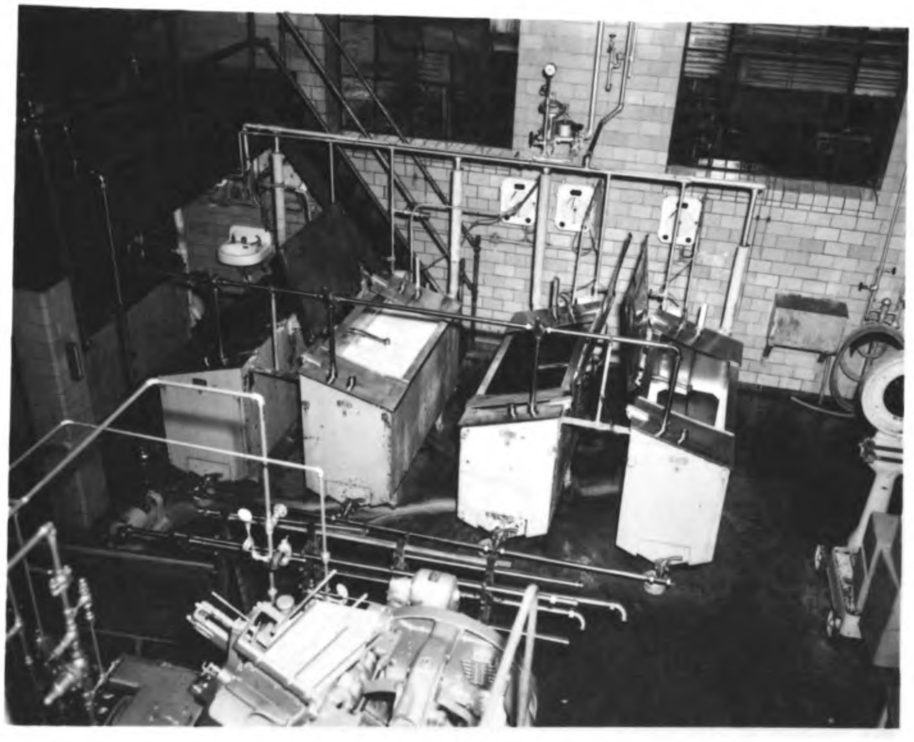

Figure 9 - Dairy "B" Milk Pasteurizing Vats

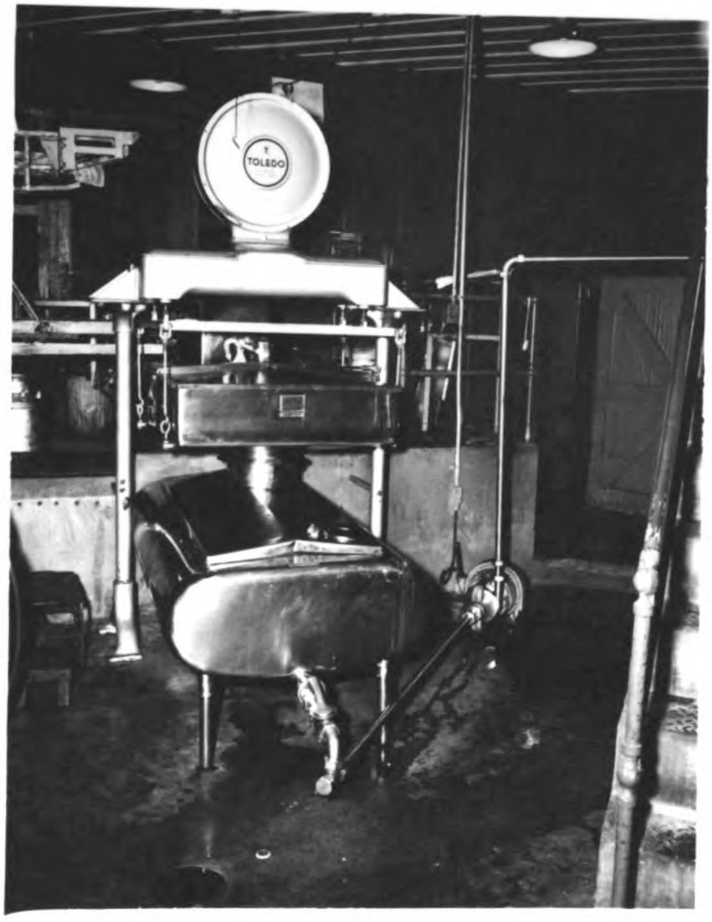

Figure 10 - Dairy "B" Weigh Tank

Figure 11 - Dairy "B" 1000 Gallon Square Milk Storage Tanks

Figure 12 - Dairy "B" 2000 Gallon Milk Storage Tank

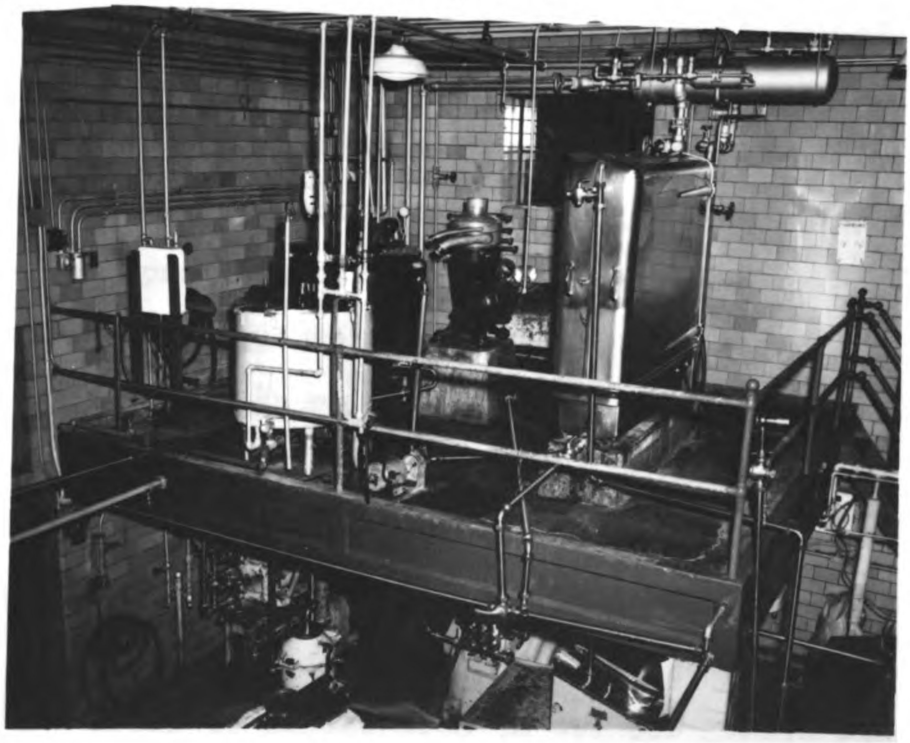

Figure 13 - Dairy "B" Cabinet Cooler, Separator, 200 Gallon Butter Milk Vat, and 100 Gallon Cream Vat

Type of Operation and Equipment - Dairy "C"

This dairy is a large diversified fluid milk operation. The products handled include bottled milk and cream, chocolate milk, butter milk and cottage cheese. In addition, this dairy operates a roller milk drier and a vacuum pan, and make some ice cream mix. In the analysis of this dairy, only the regular bottled operation and cottage cheese were considered. The plant also manufactures some butter.

The milk is received in 10 gallon cans from producer pick up trucks and is moved in and out of the dairy by roller and chain conveyers. The full milk cases are moved to and from the bottle filler by power driven chain conveyers.

Receiving Equipment - The weigh tank is a single compartment type suspended over a surge tank.

Milk Storage Equipment - This equipment consists of two 2500 gallon horizontal cylinder type tanks, and one 1000 gallon upright tank.

Pasteurizing Equipment - The milk is pasteurized in a high temperature short time system with a capacity of 12,000 pounds per hour. The milk for cottage cheese is pasteurized in two 500 gallon round vats. The butter milk is made in a 500 gallon round vat. The chocolate milk and special milk is made in two 300 gallon round vats. The cream is pasteurized in two 300 gallon square

vertical coil vats, and one 300 gallon round vertical coil vat.

Separator - The separator is of the air tight type with a capacity of 10,000 pounds per hour.

Clarifier - The clarifier has a capacity of 20,000 pounds per hour.

Homogenizer - The homogenizer is of the single stage type with a capacity of 12,000 pounds per hour.

Milk Cooling Equipment - The pasteurized products are cooled in the short time press. Two multiple section cabinet coolers are used for cooling cream and bulk milk. All of the incoming milk is cooled in a plate type cooler with a capacity of 20,000 pounds per hour. This cooler is of the narrow plate type. The cheese milk is cooled on a single section surface cooler.

Bottle Filler - The bottle filler is a 24 valve, 8 capping head type.

Cottage Cheese Equipment - This equipment consists of two spray type vats of 1000 gallon, and 800 gallon capacity.

Milk Pumps - The pumps used were 3 positive displacement pumps, and 3 centrifugal pumps.

Sanitary Pipe and Fittings - The pipe and fittings used were $1\frac{1}{2}$" and 2".

Cleaning Equipment - This equipment consisted of one 11' x 1' x 1' wash tank equipped with power driven pipe

brush, and two 4' x 2' x 2' small wash tanks plus assorted brushes and sponges.

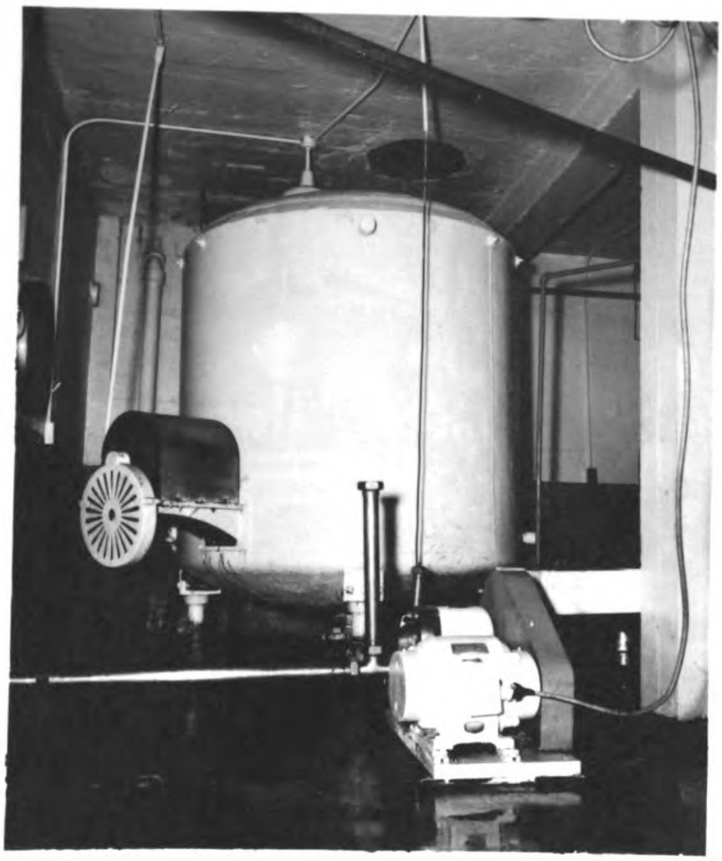

Figure 14 - Dairy "C" 1000 Gallon Milk Storage Tank and Positive Pump

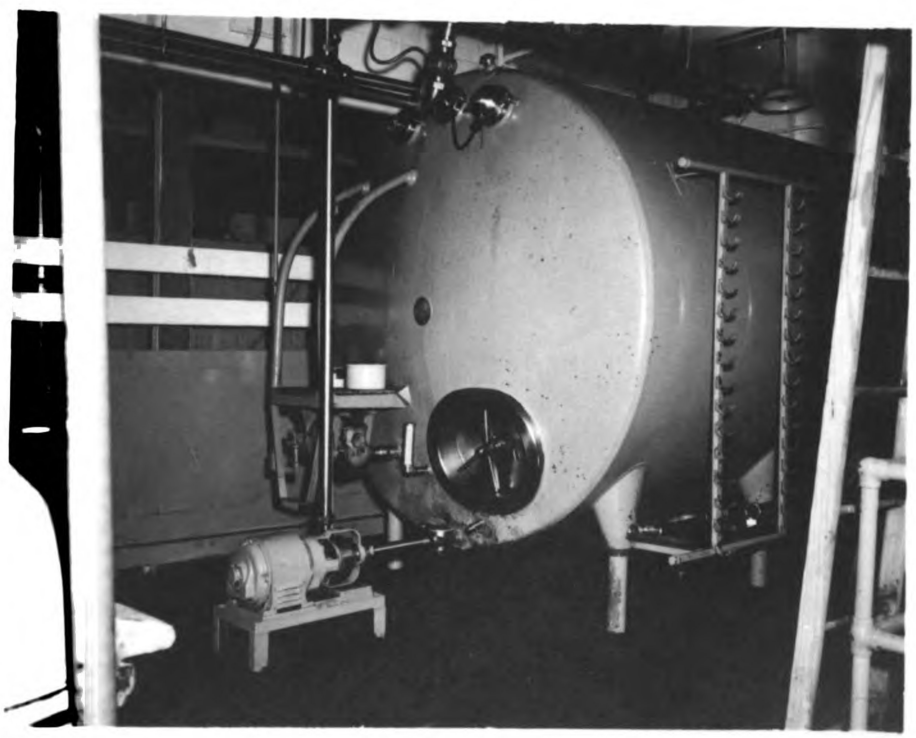

Figure 15 - Dairy "C" 2500 Gallon Milk Storage Tank and Centrifugal Pump

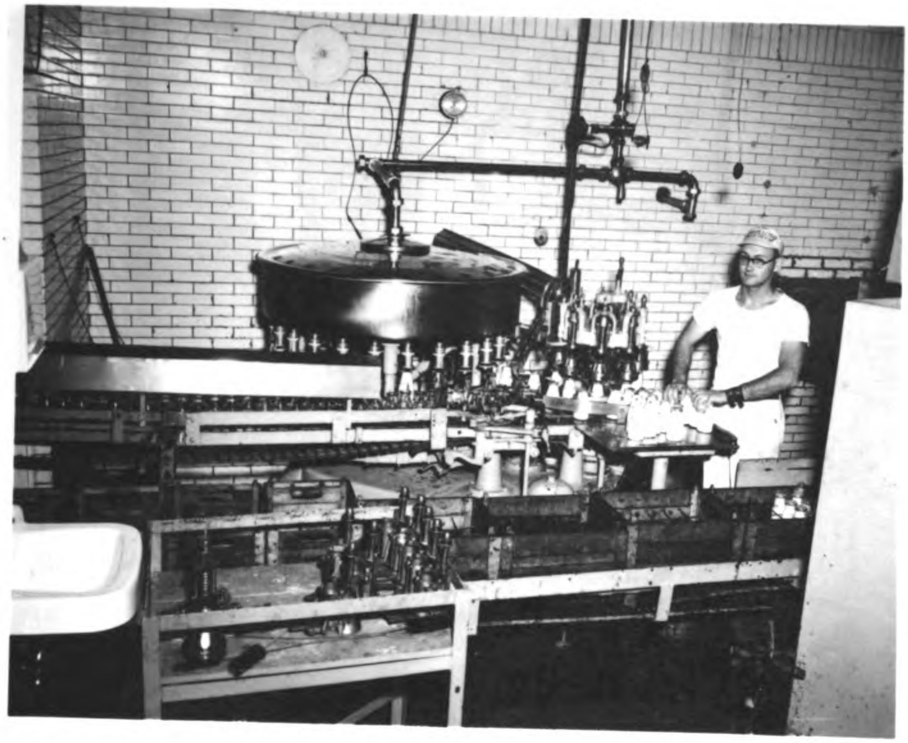

Figure 16 - Dairy "C" Bottle Filler

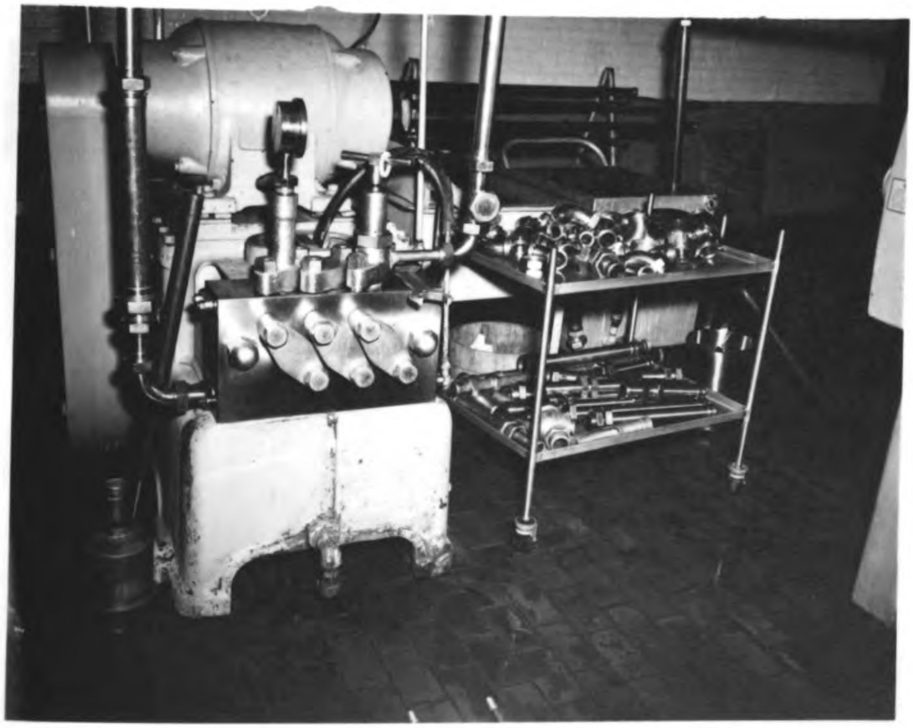

Figure 17 - Dairy "C" Homogenizer, and Small Parts Rack

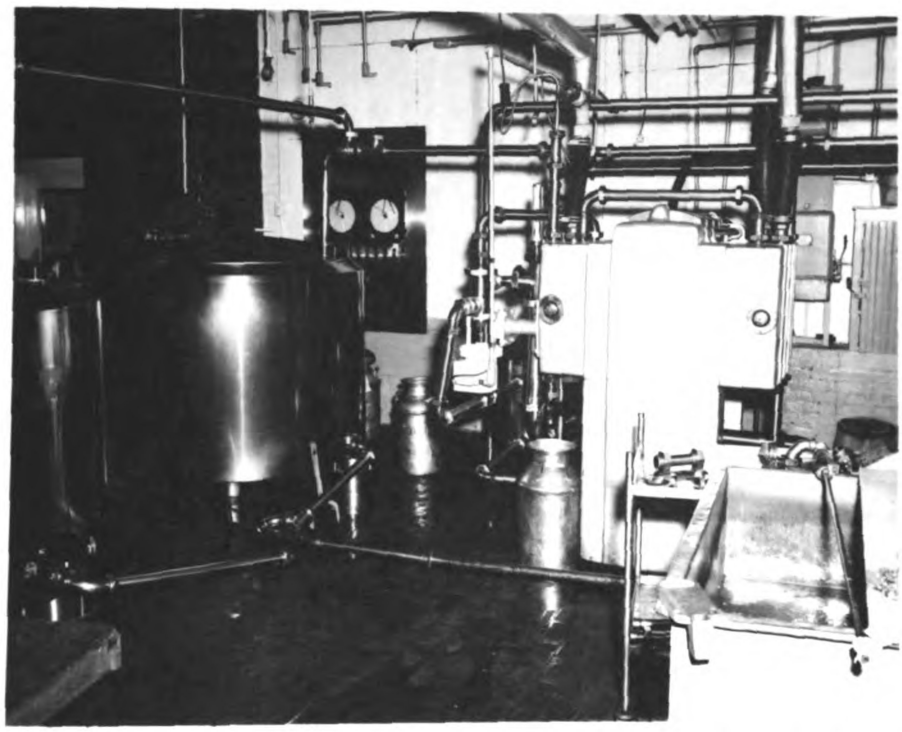

Figure 18 - Dairy "C" Short Time Pasteurizer, 300 Gallon Vats, and Small Wash Tank

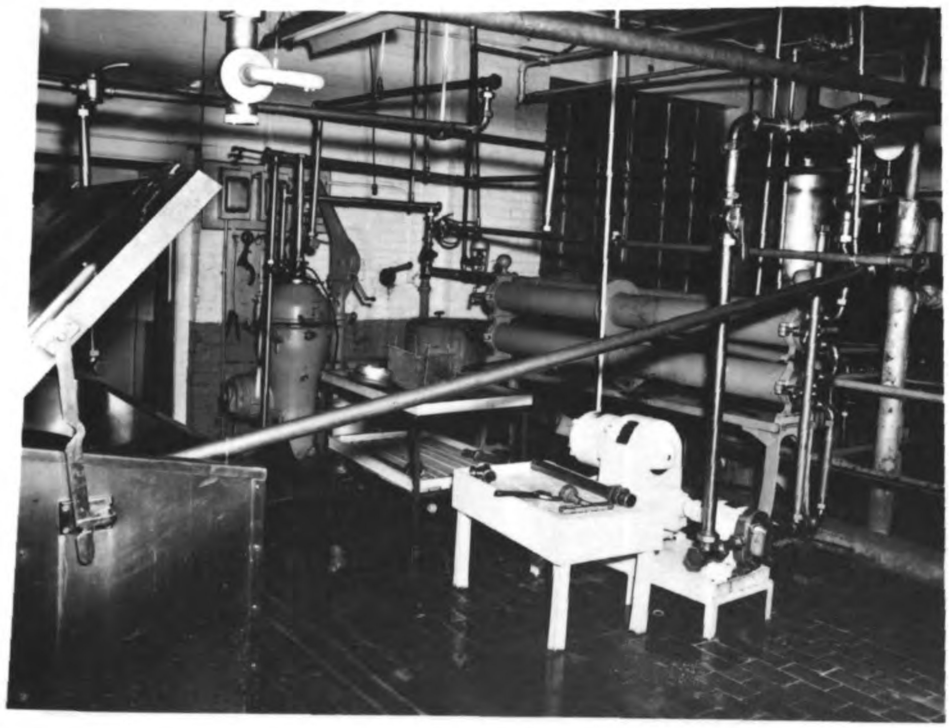

Figure 19 - Dairy "C" Separator, Preheater, and Positive Pump

Figure 20 - Dairy "C" 300 Gallon Vertical Coil Vat, and 500 Gallon Butter Milk Vat

Figure 21 - Dairy "C" 500 Gallon Cheese Milk Pasteurizing Vats and Surface Cooler

Percentage of Total Plant Labor Involved in the Cleaning Operation

The amount of labor involved in the cleaning operation in dairy plants has long been a point of discussion among dairy plant operators. The figures given for this labor by various individuals have varied widely. A figure often given is 50%. One of the reasons for the wide variance in this figure is the variation in the different methods of calculating total plant labor. If the operations of washing cans and bottles were to be considered as part of the cleaning labor, then the figure would approach 50% or even higher. In the case of a small dairy performing these operations by hand, this labor should be charged to cleaning operations.

Another cause of variance is the question of what constitutes total plant labor. If the labor of engineering and maintenance personnel, laboratory workers, plant superintendent, and route check out and check in men is charged to plant labor, the percent of labor represented by cleaning will be less.

In this study, the total plant labor was considered to be all the labor involved in receiving the milk, processing, washing and filling the bottles, and placing in the storage room.

The labor involved in loading out the route trucks was not considered, nor was the time involved in actual

checking in of the routes, but the unloading and stacking of the empty cases was considered. No engineering or maintenance labor was used. The plant superintendent's time was omitted but all working foremen and supervisors' time was included. The laboratory labor not directly concerned with plant processing was omitted. Only the daily routine cleaning operations were taken into account. Infrequent operations such as washing windows and walls were omitted.

Table 1. Percent of Total Labor Cost Represented by Cleaning Labor.

	Total Daily Man Hours	Daily Cleaning Man Hours	Percent of Total Labor Cost Represented by Cleaning Labor
Dairy "A"	49	9.26	18.89%
Dairy "B"	83	16.60	20.01%
Dairy "C"	140	24.66	17.61%

These figures would vary a small amount according to the method of calculating plant labor. But the labor included in this analysis is generally considered as the operational plant labor by most plant operators.

Breakdown of the Cleaning Operation Into Major Group Units

The following tables give a break down of the total daily cleaning time divided into major operations of assembly and disassembly, cleaning milk contact surfaces, cleaning equipment exteriors, and rinsing with water before and after cleaning.

Table 2. Time in Minutes Involved in Major Cleaning Operations - Dairy "A".

Nomenclature	Assembly and Disassembly	Rinse	Wash Exteriors	Wash Milk Contact Surfaces
3 - 200 Gallon Pasteurizing Vats	3.414	4.629	5.736	25.137
Weigh Tank	2.280	8.130	4.380	6.532
Cream Surface Cooler	3.237	2.721	.745	2.863
Cabinet Cooler	8.512	3.470	1.410	8.364
Milk Filter	4.454	.948	-----	1.423
100 Gallon Square Spray Vat	.727	1.780	2.420	2.337
500 Gallon Milk Storage Tank	1.790	5.350	-----	7.166
Bottle Filler	3.557	3.290	2.351	4.490
Acid Washing of Vats Once Per Week	-----	-----	1.400	7.370

Nomenclature	Assembly and Disassembly	Rinse	Wash Exteriors	Wash Milk Contact Surfaces
Homogenizer	26.303	2.286	1.412	14.890
Separator	18.866	4.239	2.212	22.948
Clarifier	10.487	5.000	-----	10.883
2 - Centrifugal Pumps	3.354	.600	-----	1.922
60 Gallon Vertical Coil Vat	-----	4.870	1.000	12.340
200 Gallon Cheese Vat	-----	8.420	-----	14.770
Hot Water Sterilization	-----	-----	-----	2.640
Sanitary Pipe and Fittings	123.272	33.540	-----	30.016
Total	210.253	89.273	23.066	176.091

Table 3. Time in Minutes Involved in Major Cleaning Operations - Dairy "B".

Nomenclature	Assembly and Disassembly	Rinse	Wash Exteriors	Wash Milk Contact Surfaces
Weigh Tank	1.408	9.200	5.374	16.276
3 Section Cabinet Cooler	2.090	6.948	2.645	11.205
2 - 1000 Gallon Square Storage Tanks	-----	6.120	-----	12.308
100 Gallon Round Vat	-----	3.236	3.261	7.820

Nomenclature	Assembly and Disassembly	Rinse	Wash Exteriors	Wash Milk Contact Surfaces
2000 Gallon Upright Storage Tank	1.047	4.545	-----	5.646
5 - 200 Gallon Rectangular Vats	-----	15.145	6.750	84.715
200 Gallon Round Butter Milk Vat	.528	6.447	12.291	8.830
Clarifier	19.890	8.500	2.731	14.036
Separator	10.681	8.614	2.215	17.576
6 Section Cabinet Cooler	1.368	11.578	4.562	17.571
Bottle Filler	20.383	8.150	15.604	16.567
Homogenizer	26.433	3.987	-----	11.827
4 - Centrifugal Pumps	6.440	3.464	1.028	6.504
Positive Displacement Pump	7.974	.891	.449	5.414
Preheater	9.936	2.019	-----	6.716
Sterilizing Equipment	-----	-----	-----	18.696
Sanitary Pipe and Fittings	321.098	5.050	-----	65.243
Total	428.851	103.904	56.910	326.950

Table 4. Time in Minutes Involved in Major Cleaning Operations - Dairy "C".

Nomenclature	Assembly and Disassembly	Rinse	Wash Exteriors	Wash Milk Contact Surfaces
Weigh Tank	1.555	3.544	4.843	10.302

Nomenclature	Assembly and Disassembly	Rinse	Wash Exteriors	Wash Milk Contact Surfaces
Homogenizer	.857	1.347	.354	-----
2 - 2500 Gallon Storage Tanks	4.150	11.552	-----	22.368
2 - 300 Gallon Round Pasteurizing Vats	5.390	6.056	8.564	16.018
2 - 300 Gallon Square Vertical Coil Vats	.890	9.374	7.412	29.056
3 - Positive Displacement Pumps	46.857	1.944	2.172	16.107
Preheater	3.623	.496	-----	8.429
Bottle Filler	21.584	12.939	11.631	17.861
3 - 500 Gallon Round Pasteurizing Vats	4.266	11.475	9.480	15.678
300 Gallon Round Vertical Coil Vat	-----	3.494	5.100	18.273
1000 Gallon Cheese Vat	-----	8.897	2.254	12.014
800 Gallon Cheese Vat	-----	5.701	2.320	10.139
Surface Cooler	-----	1.560	-----	9.489
40 Gallon H.T.S.T. Surge Tank	-----	.914	1.870	1.306
2 - Cabinet Coolers	20.136	13.950	5.160	23.478
Clarifier	13.712	8.610	1.069	17.577
Separator	23.340	6.858	4.285	38.285
Plate Milk Cooler	15.598	1.160	-----	31.046

Nomenclature	Assembly and Disassembly	Rinse	Wash Exteriors	Wash Milk Contact Surfaces
3 - Centrifugal Pumps	6.960	2.940	1.086	3.657
Short Time Pasteurizer less Sanitary Pipe and Fittings	17.716	21.374	2.460	28.890
Sterilizing Equipment	-----	-----	-----	10.082
Sanitary Pipe and Fittings	462.828	13.180	47.028	106.661
Total	649.462	147.365	117.088	446.716

Table 5. Percentage of Total Cleaning Labor Represented by Major Group Units.

	Assembly and Disassembly	Rinse	Wash Exteriors	Wash Milk Contact Surfaces
Dairy "A"	37.9%	15.9%	4.1%	31.7%
Dairy "B"	42.8%	10.3%	5.7%	32.6%
Dairy "C"	43.8%	9.9%	7.9%	30.2%

The type of breakdown shown in Table 5 reveals some very interesting information on what happens within the cleaning operation. The fact that around 40% of the cleaning time is involved in the assembly and disassembly of equipment and lines, shows very forcibly that no matter how efficient the actual washing operation is, large

amounts of time will be necessary for assembly and disassembly. Of course, this time can be reduced some by good motion economy, but there will be an irreducible minimum as long as the equipment is disassembled.

The actual washing of the surfaces that come in contact with the milk require about 30% of the total cleaning time. It is in this group that good cleaning methods will show substantial savings.

The washing of the equipment exteriors requires from 4 to 8% of the total cleaning time. In some pieces of equipment almost as much time is spent in washing the outside surfaces as is spent in washing the milk contact surfaces.

The rinsing of the equipment before and after washing represents from 10 to 15% of the total cleaning time. This is exclusive of the time involved in getting and returning the hose, and turning the water valves on and off.

Table 6. Time Involved in Preparing Washing Solutions, and Getting and Returning the Hose for Rinsing.

	Time in Minutes to Prepare Washing Solutions	Percentage of Cleaning Labor	Time in Minutes to Get and Return Hose	Percentage of Cleaning Labor
Dairy "A"	45.493	8.1%	10.916	1.98%
Dairy "B"	59.657	5.9%	22.330	2.20%
Dairy "C"	77.412	5.2%	41.973	2.80%

The time involved in preparing cleaning solutions represents from 5 to 8% of the total cleaning labor. This time is made up of walking and getting washing powder, filling buckets and tanks with water, and mixing the solutions.

The time required to get and return the hose, and turn the water and steam valves represents about 2.5% of the total cleaning time. This time would be much greater in many cases if the workers did not leave the hose running. It was observed that if the hose was returned and turned off at the end of each use, the time involved would be twice as great or about 5% of the total time involved. The time involved in this operation is of importance far in excess of man hours involved because it is this operation that causes the wet, sloppy conditions found in most dairies.

In general, in the cleaning of any piece of equipment, the steps necessary to complete the operations are as follows:

1. Disassemble equipment.
2. Walk to hose station, turn on water and return to equipment.
3. Rinse milk remnants from equipment.
4. Return hose to station and turn off water.
5. Walk and pick up cleaning powder or cleaning solution, brush or sponge, and return to equipment.

6. Wash milk contact surfaces.
7. Wash equipment exterior.
8. Walk to hose station, turn on water, and return to equipment.
9. Rinse equipment.
10. Return hose, turn off water, return to equipment.
11. Assemble equipment.

Analysis of the Cleaning of Individual Pieces of Equipment

Sanitary Pipe and Fittings - The cleaning of sanitary pipe and fittings represents the largest amount of cleaning time of any of the types of equipment.

	Percentage of Total Cleaning Represented by Sanitary Pipe and Fittings
Dairy "A"	34.5%
Dairy "B"	39.2%
Dairy "C"	42.6%

From 60 to 80% of this time is involved in the disassembly of the pipe and fittings, the carrying of the pipe and fittings to the wash tank, carrying the pipe and fittings back to the assembly position, and reassembly of the pipe and fittings.

	Percentage of Total Pipe and Fittings Cleaning Time Represented by Carrying Pipe and Fittings to and From the Wash Tank
Dairy "A"	8.9%
Dairy "B"	13.8%
Dairy "C"	14.9%

With the exception of Dairy "A", extreme inefficiencies existed in this operation. In Dairy "A", the pipe was taken down in large sections and carried to the wash tank and after washing, was reassembled in large sections at the wash tank and carried into position. Also, the distances traveled were relatively short. In the case of the other two dairies, the pipe for the most part was carried sections at a time back and forth to the wash tank over relatively long distances.

The hexagon nut pipe and fitting connections are a source of considerable assembly and disassembly time. The steps in this operation are as follows:

1. Loosen hex nut with wrench.
2. Unscrew hex nut by hand.
3. Place paper gasket.
4. Screw hex nut hand tight.
5. Tighten hex nut with wrench.

This operation is practically impossible to simplify in its present form.

In the actual washing of the pipe and fittings, Dairy "A" used the following system:

1. Fill wash tank with clear water.
2. Place pipe in water to soak.
3. Drain tank and fill with water and place washing powder in tank.
4. Wash pipe by a two man operation; with one man picking up the pipe and holding, while the other man runs a brush through the pipe. The pipe is then placed on a pipe rack.
5. The tank is then drained and refilled with water and a chlorine solution added.
6. The pipe is then taken from the rack and placed in the solution.
7. The tank is then drained and the pipe assembled.

As far as the actual washing of the pipe is concerned, this method is fairly fast even though two men are involved. Because of the soaking, the pipe is not washed on the outside, but the time involved in the filling and draining of the tank is a very inefficient operation.

Dairy "B" also allowed the pipe to soak. The pipe and fittings were washed as a one man operation, and after washing, the pipe and fittings were placed at the end of the tank. Then followed a very time consuming operation of placing the pipe and fittings on a pipe rack in a definite position. The pipe was then rinsed with a hose.

Dairy "C" washed their pipe and fittings in two small tanks and on one power driven, solution fed brush. The pipe and fittings were not allowed to soak and, in all cases, the pipe was washed on the outside with a metal sponge. It is interesting to note that the time required to wash the outside of the pipe is greater than the time to wash the inside. In the case of the fittings, they were not washed on the outside. After washing, the pipe was rinsed with a hose.

Separator and Clarifier - Because of the large number of the parts in this type of equipment, the assembly and disassembly time is great. This varied from 30 to 50% of the total washing time. The time involved in rinsing varied from 10 to 20% of the total time. The rinsing time is brought about by the large amount of milk slime that adheres to the parts and must be removed before washing. The time involved in washing the exteriors of this type of equipment is not large. The time required to wash the milk contact surfaces averages about 40%. Of this time, the washing of the discs requires a large part of this time.

The assembly and disassembly of this equipment was accomplished in about the same manner in all three plants. But, in the case of Dairy "C", the parts were carried almost one at a time, a long distance to the wash tank. The other two dairies used a parts rack. Dairy "B" used

a power driven, solution fed brush to wash the discs while Dairies "A" and "C" washed them by hand brush. Because of the different sizes of the discs, it was impossible to get an accurate comparison of the relative merits of the two methods.

Homogenizer - These machines are composed of many parts, some of them of very small size. The assembly and disassembly time of this type of equipment is great. The method of washing this piece of equipment followed by plants "A" and "B" was to completely disassemble the homogenizer, wash all parts with a brush, rinse and reassemble. Dairy "C" followed a radically different method which was as follows:

1. Circulate rinse homogenizer after use.
2. Connect small solution vessel to system.
3. Place cleaning powder in solution vessel and circulate solution for 25 minutes.
4. Break connection and circulate rinse for 6 minutes.

This system of cleaning has been followed for over 7 years, with only periodic disassembly for checking cleanliness and replacing gaskets. This method of cleaning results in a saving of over 40 minutes per day.

Plate Heat Exchangers - Dairy "C" was the only plant using this type of equipment. This plant used a short time high temperature system for pasteurizing the milk,

and a plate type cooler for cooling incoming raw milk. The system used to clean the cooler was to unloosen the press and wash each plate with a brush and rinse all the plates at one time with a hose. The method used to clean the short time unit was to circulate an acid and then an alkaline solution for 20 minutes each through the plates. The press was then loosened and each plate brushed with a brush and washing solution, and each plate was rinsed individually. Only the actual time involved in the cleaning of this equipment was used as during the 40 minutes of circulating time, the operator was doing other work.

In both of these operations, the disassembly and assembly time is great. The moving of each plate after washing would have to be classed as disassembly operations. In the case of the short time system, 14 minutes were required to get the circulating solutions ready. Since only cold milk was run through the cooler, it was not necessary to circulate this system.

In the calculations on the short time system the disassembly, washing, and assembly of the pipe connecting the system were not charged against the short time, but were included in the regular pipe washing operation.

Milk Pumps - In the cleaning of positive displacement pumps, from 50 to 65% of the total pump cleaning time is involved in assembly and disassembly. These pumps are

made up of many parts, several of which require a wrench for disassembly. As long as these pumps must be disassembled, there is not much chance for much motion economy. Even in the case of centrifugal pumps, the time involved in assembly and disassembly is as great or greater than the washing time.

Cabinet Coolers - An excellent example of the effect of design on the total cleaning time is given by the cabinet cooler of Dairy "A" and two more of this same type at Dairy "C". These are multiple section coolers but instead of having the sections connected to the brine and water inlets by a swivel joint, they are bolted together. This makes it necessary to spend large amounts of time in removing and replacing the headers. The assembly and disassembly percentage of the total cleaning time for the cabinet is from 30 to 36%, while in the case of the swivel type it is only around 6%. The method used in cleaning this type of equipment is to open the cabinet and then rinse the milk remnants free. A large amount of time was spent in the rinsing of the sections in this type of equipment both before and after washing. This rinsing represented 20 to 30% of the total cabinet washing time. The sections and the troughs were washed in the regular brush and bucket manner.

Bottle Fillers - The percentage of the total filler cleaning labor represented by the major group units is

as follows:

	Assembly and Disassembly	Rinse	Wash Exterior	Wash Milk Contact Surfaces
Dairy "A"	23.9%	22.1%	15.8%	30.2%
Dairy "B"	32.4%	12.9%	24.8%	26.4%
Dairy "C"	30.1%	18.1%	16.2%	25.0%

This type of equipment is also composed of a large number of parts. The type of filler in Dairy "A" was a small simple model, but the fillers in the other two plants were large complex models.

A large amount of time is involved in the washing of the exterior of the filler, particularly in the washing of the capping headers. In Dairy "B" two complete sets of complex capping headers were used, which required a large amount of time to wash.

The disassembly, washing, and reassembly of the filling valves also involve a large amount of time.

A large amount of the rinsing time was taken to rinse the exterior, such as the star wheels, guides, etc.

Pasteurizing Vats - The type of vats used in the plants were of various types, and used for many different purposes. One of the most interesting observations on the cleaning of vats with stainless steel outside liners was the large amount of time spent in washing the outside

of the equipment. In two cases, more time was spent in washing the outside surfaces of the vats than was spent in washing the interior. This was not true of painted and enameled outside surfaces, as practically no time was spent in the washing of these surfaces.

Another interesting observation was the large amount of time required to wash the coil in vertical coil vats. In all cases more time was spent in washing the coil than was spent on the interior of the vat.

The standard procedure in washing the larger vats was to get in the vat with bucket and brush. The smaller vats were washed from the outside.

The type of product used and the length of heating time in any one day govern the time required for cleaning.

Storage Tanks - The washing of storage tanks of the manhole type is a particularly distasteful job from the worker's standpoint. He is forced to crawl through the manhole and wash the interior with a brush and bucket of solution. The surfaces of the tank are very slick and he is in constant danger of falling down. The number of storage tanks of this type in the whole dairy industry that are washed satisfactorily day after day is limited. The plant superintendents themselves find it distasteful even to crawl in the vats to inspect them.

From a motion economy standpoint, the cold wall type of tank is much to be desired over the type that contains

cooling coils.

The time required to rinse these tanks represents from 27 to 30% of the total tank cleaning time. This is brought about by the worker's desire to do as much work with the hose as possible and reduce the amount of time spent in the tank.

In dairies "B" and "C" no attempt was made to sterilize the tanks after washing. Dairy "A" sterilized the tank by spraying a chlorine solution on the inside surfaces with a hand spray. This is a very desirable and efficient way to accomplish this.

Preheaters - Dairies "B" and "C" used preheaters of the multiple internal tube type. Dairy "A" did not use a preheater. The percentage of total preheater cleaning time represented by major units:

	Assembly and Disassembly	Rinse	Wash Exteriors	Wash Milk Contact Surfaces
Dairy "B"	46.0%	9.3%	----	31.1%
Dairy "C"	26.6%	3.6%	----	61.9%

The method followed by Dairy "B" was to circulate a washing solution through the tubes before cleaning. Dairy "C" did not circulate this solution. In both cases, the tubes were cleaned by running a brush through the tubes.

The circulating system increased the percentage of assembly and disassembly operation due to the assembly of the circulating system, and reduced the percentage of washing the milk contact surfaces. From a standpoint of cleanliness of equipment, the circulating system is much to be preferred.

Weigh Tanks - The percentage of the total weigh tank cleaning time represented by the major group units is as follows:

	Assembly and Disassembly	Rinse	Wash Exteriors	Wash Milk Contact Surfaces
Dairy "A"	10.9%	38.5%	20.0%	30.0%
Dairy "B"	4.1%	27.2%	15.8%	47.9%
Dairy "C"	6.8%	15.6%	21.2%	45.3%

The weigh tank used in Dairy "A" was of the two compartment type. The tank was located in a wall opening which required considerable walking back and forth in the assembly, disassembly, and rinsing operations.

Accuracy of Comparison Between the Plants Studied and Application to all Milk Plants

During this study the writer carried on correspondence with many plant operators relative to cleaning methods. Also many additional plants were visited and cleaning methods observed. The practical experience of the writer

as a dairy plant worker and superintendent was used to a great extent in the analyzing of the results.

All of the elemental time values given in the appendices have been rated as to performance in order to level out fast and slow workers and allowances added to take care of personal needs, fatigue allowance, and avoidable and unavoidable delays.

The fact that the performance was rated as to effort only, and the method not considered, the time required to clean a particular piece of equipment of the same size and type varied between the three dairies studied, and could be expected to vary in all dairies.

As was previously mentioned, the cleanliness of the equipment would have a great effect on the cleaning time. But in all cases, it was assumed that the equipment was cleaned satisfactorily.

A good worker putting out great effort would be rated high regardless of his method. A slow worker, armed with a good method, may complete the same operation faster; thus leading to some discrepancies in the rating of the performance.

The main purpose of the study was to observe the cleaning operation in three commercial plants as it exists today. From the writer's own experience, the operations appeared to be typical of the average dairy. But the question of whether a sampling of three dairies would

be a representative sampling could be justifiably raised.

As far as the effect of the performance rating and allowances are concerned, they would only effect the figures given for the percentage of total plant labor represented by cleaning. All other figures percentage-wise would not be effected by this.

In all cases the actual average time is given in the appendices for all elements.

RECOMMENDATIONS

1. The use of a hot water generator that delivers water at washing temperature to small hoses located at strategic points about the plant. The hoses are equipped with a press type shut off valve at the nozzle end. This should save from 3 to 5% of the cleaning labor. In addition, it saves large amounts of water as well as helping to eliminate wet, sloppy conditions.

2. The use of a central cleaning solution tank in which the cleaning solutions can be made up to correct strength and then piped to strategic plant locations. In the three dairies studied 5 to 8% of the cleaning time was involved in preparing cleaning solutions in buckets. In addition, the solution can be kept at the same strength and much waste is eliminated.

3. If local regulatory officials will permit the installation of glass pipe lines which can be cleaned in place, or the in place cleaning of existing stainless steel lines, it would be highly desirable. The time involved in the cleaning of sanitary pipe is the largest single item of cleaning expense. The amount of labor savings possible here would depend on the amount of pipe handled in this manner.

4. The following method of cleaning sanitary pipe and fittings is recommended:

a. Use a pipe rack that is on wheels to eliminate walking back and forth to the wash tank.

b. Place the pipe and fittings on this rack in a definite order and then wheel it to the wash tank.

c. Use a power driven pipe brush with revolving brushes on the inside and outside. This will enable the pipe to be washed on the outside at the same time it is being washed on the inside. The brushes are solution fed. The wash tank should be equipped with a rinse pipe which will enable the pipe to be rinsed on the inside and outside at the tank. The pipe should then be placed back on the rack in the same place.

d. Use a small fittings wash tank composed of two power driven solution fed brushes which will wash the fittings on the inside and outside at the same time. A small stream of water from a pipe in the rinse side will enable quick rinsing. The fitting is then put back on the rack in a definite position.

e. The pipe rack is then pushed along the assembly route, assembling each piece in order.

5. Serious consideration should be given to the use of steam jet cleaning, using the Venturi principle for

the cleaning of equipment exteriors. A fairly large amount of cleaning time is involved in this operation and since the equipment exterior does not effect the product quality, some savings are possible here. With this kind of a system, the exteriors of the equipment would all be cleaned at the same time.

6. Pump fed jets have recently been used in the cleaning of cold milk storage tanks of the manhole type. The use of this system eliminates the necessity of the man getting in the tank and, according to reports, the machine cleans very satisfactorily.

7. The use of parts racks on wheels for all pieces of equipment composed of a large number of parts such as the homogenizer, separator, and clarifier.

8. The use of solution fed revolving brushes for the cleaning of separator and clarifier discs.

9. The cleaning operation should be a carefully planned operation with a fairly definite method for each operation. A new man placed on the clean up job should be carefully supervised until he knows the operation.

10. The plant layout should be planned in a functional manner to reduce walking time in the cleaning operation.

CONCLUSIONS

1. The use of time and motion study as a means of analyzing cleaning operations brings out some hidden information that would be difficult to observe by any other method.

2. The percentage of total plant labor represented by the cleaning operations in the three dairies was:

Dairy "A"	18.89%
Dairy "B"	20.01%
Dairy "C"	17.61%

3. The percentage of total cleaning labor represented by major group units was:

	Assembly and Disassembly	Rinse	Wash Exteriors	Wash Milk Contact Surface
Dairy "A"	37.9%	15.9%	4.1%	31.7%
Dairy "B"	42.8%	10.3%	5.7%	32.6%
Dairy "C"	43.8%	9.9%	7.9%	30.2%

4. No matter how efficient the actual cleaning operation is, large amounts of time will still be necessary for assembly and disassembly.

5. Some motion economy can be incorporated into the assembly and disassembly operation, but as long as the equipment is disassembled, it will require changes in design to effect large savings.

6. Considerable amounts of time are spent by the clean up worker in just holding the hose and rinsing equipment.

7. In some pieces of equipment as much time is spent in washing the outside of the equipment as is spent in washing the milk contact surfaces.

8. Percentage of total cleaning labor represented by preparing washing solutions:

Dairy "A"	8.1%
Dairy "B"	5.9%
Dairy "C"	5.2%

9. Percentage of total cleaning labor represented by getting and returning hose:

Dairy "A"	1.98%
Dairy "B"	2.20%
Dairy "C"	2.80%

10. The importance of the above operation is far in excess of the labor involved because of the wet, sloppy conditions caused by this operation. Also, if the water was not left running by the operator in many cases, the percentage value for this operation would be about twice as great.

11. The disassembly, washing, and reassembly of sanitary pipe and fittings requires the following percentages of total cleaning labor:

Dairy "A"	34.5%

Dairy "B"	39.2%
Dairy "C"	42.6%

12. Of the above time, 60 to 80% is involved in assembly and disassembly, and carrying the pipe and fittings to and from the wash tank.

13. A number of cleaning aids are now available that, from a motion economy standpoint, show some promise.

14. The design of equipment to reduce assembly and disassembly time is greatly needed.

15. One very promising solution to the dairy cleaning problem, if and when it becomes possible, is the cleaning by circulating methods with the equipment so designed and constructed that it may be permanently assembled.

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APPENDICES

Appendix A

Table A-1. Dairy "A" 200 Gallon Round Pasteurizing Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 30 ft. and get brushes and cleaning solution and return to vat.	.387	150%	.580
2.	Raise vat cover.	.045	"	.067
3.	Take out thermometer stem.	.10	"	.150
4.	Remove milk outlet valve.	.188	"	.282
5.	Climb in vat with hose.	.25	"	.375
6.	Wash inside vat with steel sponge using continuous motion and rinsing.	2.28	"	3.420
7.	Wash inside vat cover with brush and cleaning solution.	.847	"	1.270
8.	Wash inside vat with brush and cleaning solution using continuous motion.	1.09	"	1.630
9.	Climb out of vat.	.071	"	.106
10.	Rinse inside of vat.	.474	"	.711
11.	Close cover.	.038	"	.057
12.	Wash thermometer bulb.	.134	"	.201
13.	Wash top of cover.	.706	"	1.050
14.	Wash outside of vat.	.575	"	.862
15.	Wash outlet valve.	.918	"	1.377
16.	Rinse outside of vat.	.555	"	.832
17.	Replace outlet valve.	.426	"	.639
	Total Cycle Time			13.609

Performance Rating	130%
Allowances	20%
Total	150%

Table A-2. Dairy "A" Weigh Tank

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove right strainer compartment.	.136	150%	.204
2.	Remove left strainer compartment.	.132	"	.198
3.	Walk 15 ft. through door to other side of tank.	.221	"	.331
4.	Remove weigh tank cover.	.158	"	.237
5.	Pull out surge tank	.216	"	.324
6.	Walk 7 ft. to hose and turn on water and return to tank.	.250	"	.375

Appendix A

Table A-2. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
7.	Rinse strainers and one half of tank.	.910	150%	1.365
8.	Walk 15 ft. through door to other side of tank.	.232	"	.348
9.	Rinse other side of tank and surge tank.	.923	"	1.384
10.	Walk 10 ft. get bucket of cleaning solution and brushes and return to tank.	.304	"	.456
11.	Wash inside and outside of surge tank with brush using continuous motion.	1.560	"	2.340
12.	Wash weigh tank cover.	.848	"	1.270
13.	Wash right dump compartment.	.939	"	1.400
14.	Wash left dump compartment.	.866	"	1.299
15.	Wash outside of dump tank.	1.060	"	1.590
16.	Walk 15 ft. through door to other side of tank.	.235	"	.352
17.	Wash right strainer.	.757	"	1.130
18.	Wash left strainer.	.793	"	1.180
19.	Wash outside of dump end of tank.	1.060	"	1.590
20.	Rinse strainers with hose.	.798	"	1.190
21.	Walk 15 ft. with hose to other side of tank.	.242	"	.363
22.	Rinse surge tank and cover and dump compartment.	.804	"	1.200
23.	Place surge tank.	.122	"	.183
24.	Place weigh tank cover.	.214	"	.321
25.	Walk 15 ft. through door.	.222	"	.333
26.	Replace right strainer.	.155	"	.232
27.	Replace left strainer.	.161	"	.241
	Total Cycle Time			21.430

Performance Rating	130%
Allowances	20%
Total	150%

Table A-3. Dairy "A" Small Cream Surface Cooler

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove shields.	.602	150%	.903
2.	Remove top distribution trough.	.213	"	.319

Appendix A

Table A-3. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
3.	Remove bottom distribution trough.	.205	150%	.307
4.	Rinse cooler.	.810	"	1.211
5.	Wash left shield with brush and solution.	.495	"	.742
6.	Wash right shield.	.489	"	.747
7.	Wash top trough.	.315	"	.472
8.	Wash bottom trough.	.306	"	.459
9.	Wash right side of cooler.	.395	"	.592
10.	Wash left side of cooler.	.399	"	.598
11.	Rinse with hose.	1.01	"	1.510
12.	Replace top trough.	.217	"	.325
13.	Replace bottom trough.	.214	"	.321
14.	Replace shields.	.708	"	1.062
	Total Cycle Time			9.240

Performance Rating	130%
Allowances	20%
Total	150%

Table A-4. Dairy "A" Multiple Section Cabinet Cooler

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 30 ft. and get bucket of cleaning solution and return to cooler.	.688	100%	.688
2.	Unscrew holding screw and pull right shield back.	.454	"	.454
3.	Unscrew holding screw and pull left shield back.	.602	"	.602
4.	Remove top trough and cover.	.430	"	.430
5.	Remove brine and water headers.	1.62	"	1.62
6.	Walk 10 ft. turn on water in hose and return to cooler.	.304	"	.304
7.	Rinse with hose.	1.25	"	1.25
8.	Wash inside of right shield.	.403	"	.403
9.	Wash right side of first cooling section.	.310	"	.310
10.	Push against shield.	.114	"	.114
11.	Wash left side of first cooling section.	.321	"	.321
12.	Wash right side of second cooling section.	.314	"	.314

Appendix A

Table A-4. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
13.	Push section against shield.	.110	100%	.110
14.	Wash left side of second section.	.301	"	.301
15.	Wash right side of center section.	.319	"	.319
16.	Wash inside of left shield.	.391	"	.391
17.	Wash left side of fourth cooling section.	.335	"	.335
18.	Push section against shield.	.108	"	.108
19.	Wash right side of section.	.313	"	.313
20.	Wash left side of fifth section.	.322	"	.322
21.	Push section against shield.	.112	"	.112
22.	Wash right side of section.	.325	"	.325
23.	Wash right side of center section.	.339	"	.339
24.	Wash top trough.	1.65	"	1.65
25.	Wash cover.	.242	"	.242
26.	Wash shield plates.	.555	"	.555
27.	Wash bottom trough.	1.48	"	1.48
28.	Wash outside of cooler.	1.41	"	1.41
29.	Rinse cooler.	2.22	"	2.22
30.	Push two right sections in place.	.158	"	.158
31.	Push two left sections in place.	.176	"	.176
32.	Replace headers.	3.24	"	3.24
33.	Replace top trough.	.571	"	.571
34.	Replace cover.	.132	"	.132
35.	Push right shield into place and fasten.	.558	"	.558
36.	Push left shield into place and fasten.	.571	"	.571
	Total Cycle Time			22.900

Performance Rating 80%
Allowances 20%
Total 100%

Appendix A

Table A-5. Dairy "A" Milk Filter

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Unscrew screws holding plates.	.495	150%	.742
2.	Raise top plate.	.082	"	.123
3.	Remove used filter cloth.	.103	"	.154
4.	Remove support screen.	.225	"	.337
5.	Rinse with hose.	.314	"	.471
6.	Wash plates with brush and solution using continuous motion.	.643	"	.964
7.	Wash support screen.	.306	"	.459
8.	Rinse with hose.	.318	"	.477
9.	Walk 30 ft. and get new filter cloth and return to filter.	.451	"	.676
10.	Place filter cloth.	.089	"	.133
11.	Replace support screen.	.218	"	.327
12.	Lower top plate.	.088	"	.132
13.	Tighten holding screws.	1.22	"	1.830
	Total Cycle Time			6.825

Performance Rating	130%
Allowances	20%
Total	150%

Table A-6. Dairy "A" 100 Gallon Spray Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 30 ft. get brushes and bucket and cleaning solution and return to vat.	.422	120%	.506
2.	Walk 30 ft. turn on water and return with hose to vat.	.505	"	.606
3.	With hose in one hand and steel sponge in other, scour and rinse inside vat.	.786	"	.943
4.	Dump bucket of solution in vat.	.172	"	.206
5.	Wash inside of vat with brush and solution, using continuous motion.	.795	"	.954
6.	Pull plug valve and wash with brush.	.195	"	.234
7.	Disassemble pump.	.419	"	.502
8.	Wash pump with brush and solution.	1.43	"	1.710

Appendix A

Table A-6. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
9.	Wash outside of vat with brush.	2.02	120%	2.420
10.	Rinse inside and outside with hose.	1.49	"	1.780
11.	Assemble valve.	.188	"	.225
12.	Assemble pump.	1.43	"	1.710
	Total Cycle Time			11.796

Performance Rating	100%
Allowances	20%
Total	120%

Table A-7. Dairy "A" 500 Gallon Milk Storage Tank

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Open manhole.	.255	110%	.280
2.	Walk 40 ft. get bucket of cleaning solution and brushes and return to vat.	.643	"	.707
3.	Walk 10 ft. and turn on water in hose and return to vat.	.229	"	.251
4.	Rinse vat.	3.01	"	3.310
5.	Climb through manhole.	.229	"	.251
6.	Wash inside of vat with brush and solution, using continuous brushing motion.	3.38	"	3.710
7.	Climb out of tank.	.170	"	.187
8.	Wash manhole port cover.	.733	"	.806
9.	Wash plug valve.	.767	"	.843
10.	Rinse inside tank with hose.	1.86	"	2.040
11.	Walk 60 ft. and get chlorine hand spray and return to vat.	1.91	"	2.100
12.	Spray inside vat with chlorine	1.48	"	1.620
13.	Close manhole.	1.38	"	1.510
14.	Return chlorine spray, walk 60 ft.	.532	"	.585
	Total Cycle Time			18.200

Performance Rating	90%
Allowances	20%
	110%

Appendix A

Table A-8. Dairy "A" Bottle Filler

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove bowl cover.	.126	100%	.126
2.	Raise bowl.	.105	"	.105
3.	Remove holding clips from valve filling assemblies.	.287	"	.287
4.	Place valve assemblies in bucket.	.326	"	.326
5.	Walk 30 ft. and get brushes and solution, return to filler.	.644	"	.644
6.	Walk 30 ft. and turn on water in hose and return with hose.	.535	"	.535
7.	Rinse bowl and outside filler.	1.91	"	1.91
8.	Wash inside and outside bowl with brush and solution.	2.39	"	2.39
9.	Wash capping headers.	1.96	"	1.96
10.	Wash filling valves with brush and solution without removing from bucket.	.630	"	.630
11.	Wash bowl cover.	1.47	"	1.47
12.	Rinse filler.	1.38	"	1.38
13.	Replace filling valves in bowl.	2.57	"	2.57
14.	Replace cover.	.143	"	.143
15.	Wash filler frame work.	.391	"	.391
	Total Cycle Time			14.867

Performance Rating	80%
Allowances	20%
Total	100%

Table A-9. Dairy "A" Acid Washing of 200 Gallon Vats Once Per Week

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 60 ft. and get acid and return to vat with brushes.	1.362	150%	2.043
2.	Turn on water and fill bucket.	.328	"	.492
3.	Place acid in bucket.	.102	"	.153
4.	Climb into vat.	.094	"	.141
5.	Spread layer of acid solution on walls of vat with brush, using continuous motion.	2.106	"	3.150

Appendix A

Table A-9. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
6.	Climb out of vat.	.088	150%	.132
7.	Spread layer of acid on outside of vat.	.832	"	1.248
8.	Spread layer of acid on thermometer stem.	.094	"	.141
9.	Spread layer of acid on outlet valve.	.764	"	1.146
10.	Wait for acid to act.	2.858	"	4.287
11.	Climb into vat with hose.	.124	"	.186
12.	Wash with hose and brush using continuous motion.	3.290	"	4.935
13.	Get out of vat.	.108	"	.162
14.	Wash outside of vat with brush.	2.178	"	3.267
15.	Wash valve.	1.014	"	1.521
	Total Cycle Time			23.004

Performance Rating	130%
Allowances	20%
Total	150%

Table A-10. Homogenizer Dairy "A"

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Push parts platform in place.	.547	120%	.656
2.	Remove plunger rod guard.	.178	"	.213
3.	Loosen packing gland tie rods.	.510	"	.612
4.	Remove gauge.	.268	"	.321
5.	Remove pressure regulating assembly.	.777	"	.932
6.	Loosen suction inlet and suction manifold port cover nuts.	.407	"	.488
7.	Remove tie rods and plunger port covers.	1.61	"	1.930
8.	Loosen plunger rods.	.405	"	.486
9.	Remove plunger rod, packing gland, and packing box.	.890	"	1.060
10.	Repeat above.	.790	"	.948
11.	Repeat above.	.791	"	.949
12.	Remove discharge valves.	.271	"	.325
13.	Remove suction valves.	.322	"	.386
14.	Remove gaskets.	.284	"	.340

Appendix A

Table A-10. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
15.	Remove suction inlet port.	.489	120%	.586
16.	Remove manifold port cover.	.497	"	.596
17.	Remove gauge well.	.420	"	.504
18.	Loosen discharge valve cover nuts.	.388	"	.465
19.	Remove discharge valve covers.	.408	"	.489
20.	Remove gaskets from packing gland.	1.47	"	1.760
21.	Remove milk outlet assembly.	.407	"	.488
22.	Walk 20 ft. turn on water in hose and return.	.434	"	.520
23.	Rinse all parts and block.	.975	"	1.170
24.	Walk 20 ft. and get bucket of cleaning solution and brushes.	.502	"	.602
25.	Wash plunger rod.	.295	"	.354
26.	Repeat above.	.307	"	.368
27.	Repeat above.	.306	"	.367
28.	Wash two tie rods.	.301	"	.361
29.	Repeat above.	.306	"	.367
30.	Repeat above.	.322	"	.386
31.	Wash packing box.	.272	"	.326
32.	Repeat above.	.292	"	.350
33.	Repeat above.	.294	"	.352
34.	Wash packing gland.	.314	"	.376
35.	Repeat above.	.319	"	.382
36.	Repeat above.	.329	"	.394
37.	Wash discharge valve cover.	.201	"	.241
38.	Repeat above.	.209	"	.250
39.	Repeat above.	.199	"	.238
40.	Wash side suction inlet port.	.204	"	.244
41.	Wash manifold port cover.	.193	"	.231
42.	Wash suction valve.	.186	"	.223
43.	Repeat above.	.208	"	.249
44.	Repeat above.	.198	"	.237
45.	Wash discharge valve.	.204	"	.244
46.	Repeat above.	.204	"	.244
47.	Repeat above.	.208	"	.249
48.	Wash gauge stem.	.429	"	.514
49.	Wash milk outlet assembly.	.343	"	.411
50.	Wash pressure regulating valve body.	.464	"	.556
51.	Wash gauge well.	.312	"	.374
52.	Wash hex nuts.	.375	"	.450
53.	Wash outside of block.	.811	"	.973
54.	Wash block port holes.	.467	"	.560

Appendix A

Table A-10. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
55.	Wash plunger rod port cover.	.302	120%	.362
56.	Repeat above.	.301	"	.362
57.	Repeat above.	.306	"	.367
58.	Wash outside homogenizer frame.	.366	"	.439
59.	Wash lower plunger.	.144	"	.172
60.	Wash valve adapter.	.166	"	.199
61.	Wash breaker ring.	.199	"	.238
62.	Wash upper valve seat.	.171	"	.205
63.	Wash lower valve seat.	.164	"	.196
64.	Wash double ended valve plug.	.177	"	.212
65.	Wash packing gland.	.104	"	.124
66.	Walk 20 ft. and get bucket of chlorine and return.	.489	"	.586
67.	Rinse parts in solution.	.513	"	.615
68.	Rinse block with solution.	.418	"	.501
69.	Place packing gland gaskets.	.211	"	.253
70.	Place gaskets in block.	.615	"	.738
71.	Assemble plunger rods, packing box and gland.	.630	"	.756
72.	Repeat above.	.633	"	.759
73.	Repeat above.	.630	"	.756
74.	Assemble plunger port covers and tie rods.	.506	"	.607
75.	Repeat above.	.523	"	.627
76.	Repeat above.	.522	"	.626
77.	Place gauge well.	.162	"	.194
78.	Place discharge valve covers.	.323	"	.387
79.	Place milk outlet assembly.	.503	"	.603
80.	Assemble and place pressure control valve.	.728	"	.873
81.	Place discharge valves.	.198	"	.237
82.	Place suction valves.	.268	"	.321
83.	Place gauge.	.230	"	.276
84.	Place suction inlet nuts and manifold port.	.498	"	.597
85.	Place discharge valve cover nuts.	.684	"	.820
86.	Tighten all nuts with wrench.	2.65	"	3.180
87.	Replace guard.	.252	"	.302
	Total Cycle Time			45.149

Performance Rating	100%
Allowances	20%
Total	120%

Appendix A

Table A-11. Dairy "A" Separator

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 60 ft. and return with parts platform.	1.02	150%	1.530
2.	Remove control valve head.	.326	"	.489
3.	Remove valve body.	.196	"	.294
4.	Remove valve seat disc.	.052	"	.078
5.	Remove coupling ring.	.223	"	.334
6.	Remove coupling nut.	.188	"	.282
7.	Remove cream control base.	.104	"	.156
8.	Remove cream seal.	.052	"	.078
9.	Remove check valve.	.060	"	.090
10.	Remove milk outlet assembly.	.114	"	.171
11.	Remove milk outlet seal.	.057	"	.085
12.	Remove frame cover.	.251	"	.376
13.	Remove bowl coupling ring.	.395	"	.592
14.	Remove bowl top and top disc.	.119	"	.178
15.	Remove disc carrier and discs.	.224	"	.336
16.	Remove bowl locking nut.	.218	"	.327
17.	Remove bottom bowl shell.	.272	"	.408
18.	Remove milk inlet connections.	.651	"	.976
19.	Walk 10 ft. and turn on water in hose and return with hose to separator.	.297	"	.445
20.	Rinse parts.	2.829	"	4.239
21.	Wash outside of separator with brush and hose.	1.475	"	2.212
22.	Move parts platform to wash tank.	.462	"	.693
23.	Turn on water in washand rinse tanks.	.082	"	.123
24.	Put wash powder in tank.	.212	"	.318
25.	Place all parts in wash tank.	1.542	"	2.313
26.	Wash valve body and place in rinse tank.	.113	"	.169
27.	Wash valve stem and place in rinse tank.	.124	"	.186
28.	Wash valve seat disc and place in rinse tank.	.092	"	.138
29.	Wash coupling ring and place and place in rinse tank.	.166	"	.249
30.	Wash cream control base and place in rinse tank.	.162	"	.243
31.	Wash cream seal and place in rinse tank.	.122	"	.183
32.	Wash check valve and place in rinse tank.	.057	"	.085
33.	Wash coupling ring and place in rinse tank.	.089	"	.133

Appendix A

Table A-11. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
34.	Wash milk outlet assembly and place in rinse tank.	.229	150%	.343
35.	Wash outlet seal and place in rinse tank.	.157	"	.235
36.	Wash reinforcing cup and place in rinse tank.	.083	"	.124
37.	Wash elbow and place in rinse tank.	.114	"	.171
38.	Wash seal ring and reducer and place in rinse tank.	.101	"	.151
39.	Wash reinforcing cup and place in rinse tank.	.104	"	.156
40.	Wash inlet seal and place in rinse tank.	.102	"	.153
41.	Wash holder and place in rinse tank.	.096	"	.144
42.	Wash bowl coupling ring and place in rinse tank.	.383	"	.574
43.	Wash bowl top and place in rinse tank.	1.072	"	1.608
44.	Wash top disc and place in rinse tank.	.334	"	.501
45.	Wash disc carrier and place in rinse tank.	.819	"	1.228
46.	Wash bowl locking nut and place in rinse tank.	.114	"	.171
47.	Wash bowl rubber and place in rinse tank.	.204	"	.306
48.	Wash bowl shell and place in rinse tank.	.833	"	1.249
49.	Wash disc and place in rinse -- average time for 1 disc is .111 -- total discs 54.	5.994	"	8.991
50.	Remove parts from rinse and place on platform.	1.334	"	2.010
51.	Push parts platform to separator.	.494	"	.741
52.	Place bowl shell.	.271	"	.406
53.	Place bowl locking nut.	.386	"	.579
54.	Place disc carrier.	.123	"	.186
55.	Place disc -- average time for 1 disc is .051 -- total discs 54.	2.750	"	4.125
56.	Place top disc.	.117	"	.175
57.	Place bowl top.	.508	"	.762
58.	Place bowl coupling ring.	.347	"	.520

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Table A-11. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
59.	Place frame cover.	.248	150%	.372
60.	Place milk outlet assembly.	.253	"	.379
61.	Place milk outlet seal.	.116	"	.174
62.	Place check valve.	.191	"	.286
63.	Place cream seal.	.055	"	.082
64.	Place cream control base.	.149	"	.223
65.	Place coupling nut.	.081	"	.121
66.	Place coupling ring.	.187	"	.280
67.	Place valve seat disc.	.059	"	.088
68.	Place valve body.	.126	"	.189
69.	Place control valve head.	.230	"	.345
70.	Assemble milk inlet assembly.	1.025	"	1.537
71.	Place milk inlet assembly.	.344	"	.516
	Total Cycle Time			48.711

Performance Rating	130%
Allowances	20%
Total	150%

Table A-12. Dairy "A" Clarifier

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 60 ft. and return with parts platform.	1.100	150%	1.650
2.	Remove milk outlet coupling ring.	.246	"	.369
3.	Remove milk outlet connection.	.109	"	.163
4.	Remove frame cover.	.232	"	.348
5.	Remove bowl coupling ring.	.397	"	.595
6.	Remove bowl top.	.118	"	.177
7.	Remove bowl rubber.	.119	"	.178
8.	Remove disc carrier and discs.	.210	"	.315
9.	Remove bowl locking nut.	.210	"	.315
10.	Remove bowl shell.	.284	"	.426
11.	Push parts platform to wash tank.	.486	"	.729
12.	Place parts in wash tank.	.933	"	1.399
13.	Wash milk outlet coupling ring and place in rinse tank.	.196	"	.294
14.	Wash milk outlet connection and place in rinse tank.	.214	"	.321

Appendix A

Table A-12. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
15.	Wash bowl rubber and place in rinse tank.	.144	150%	.171
16.	Wash bowl coupling ring and place in rinse tank.	.337	"	.505
17.	Wash bowl top and place in rinse tank.	.873	"	1.309
18.	Wash bowl shell and place in rinse tank.	.728	"	1.092
19.	Wash disc and place in rinse -- average time for 1 disc is .099 -- total discs 40.	3.960	"	5.940
20.	Remove parts from rinse.	.834	"	1.251
21.	Push parts platform to separator.	.498	"	.747
22.	Place bowl shell.	.307	"	.460
23.	Place bowl locking nut.	.377	"	.565
24.	Place disc carrier.	.119	"	.178
25.	Place disc -- average time for 1 disc is .056 -- total discs 40.	2.240	"	3.360
26.	Place bowl top.	.513	"	.769
27.	Place bowl coupling ring.	.331	"	.496
28.	Place frame cover.	.234	"	.351
29.	Place milk outlet connections.	.218	"	.327
30.	Place milk outlet coupling ring.	.213	"	.319
	Total Cycle Time			24.390

Performance Rating	130%
Allowances	20%
Total	150%

Table A-13. Dairy "A" Centrifugal Milk Pump

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Unscrew holding screws.	.099	150%	.148
2.	Disassemble pump.	.268	"	.402
3.	Wash milk inlet and outlet assembly.	.216	"	.324
4.	Wash impeller.	.113	"	.169
5.	Wash spring.	.096	"	.144

Appendix A

Table A-13. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
6.	Wash back plate.	.218	150%	.324
7.	Rinse pump.	.200	"	.300
8.	Place back plate gasket.	.107	"	.160
9.	Place back plate.	.168	"	.252
10.	Place spring.	.061	"	.091
11.	Place impeller.	.054	"	.081
12.	Place milk inlet and outlet assembly.	.150	"	.225
13.	Tighten holding screws.	.212	"	.318
	Total Cycle Time			2.930

Performance Rating	130%
Allowances	20%
Total	150%

Table A-14. Dairy "A" 60 Gallon Round Butter Milk Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 20 ft. turn on hose and return to vat.	.344	140%	.480
2.	Walk 30 ft. get bucket of cleaning solutions and return to vat.	.416	"	.582
3.	Rinse vat.	1.87	"	2.61
4.	Wash inside of vat.	3.45	"	4.83
5.	Wash cooling coil.	3.83	"	5.36
6.	Wash underside of vat cover.	.757	"	1.05
7.	Wash outside of vat.	.719	"	1.00
8.	Wash outlet valve.	.790	"	1.10
9.	Rinse vat.	1.62	"	2.26
10.	Walk 20 ft. turn off hose, and return to vat.	.352	"	.492
	Total Cycle Time			19.76

Performance Rating	120%
Allowances	20%
Total	140%

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Table A-15. Dairy "A" 200 Gallon Cheese Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 15 ft. turn on hose and return to vat.	.277	150%	.415
2.	Rinse vat.	2.01	"	3.01
3.	Fill 1/3 full with water.	1.48	"	2.22
4.	Walk 15 ft. get dipper of powder and return to vat.	.276	"	.414
5.	Wash vat with steel sponge.	6.16	"	9.24
6.	Wash strainer.	1.20	"	1.80
7.	Wash cheese knives.	1.01	"	1.51
8.	Rinse vat.	1.65	"	2.47
9.	Rinse cheese curd from floor.	1.96	"	2.94
10.	Walk 15 ft. turn off hose, and return to vat.	.275	"	.412
	Total Cycle Time			24.43

Performance Rating	130%
Allowances	20%
Total	150%

Table A-16. Dairy "A" Hot Water Sterilization of Equipment

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowance Time in Minutes
1.	Walk 25 ft. to 200 gallon vat.	.236	100%	.236
2.	Turn on hose and place in vat.	.094	"	.094
3.	Turn steam on vat.	.066	"	.066
4.	Start vat agitator	.048	"	.048
5.	Walk 10 ft. to surface cooler and turn on steam.	.176	"	.176
6.	Walk 10 ft. and open vat outlet valve.	.194	"	.194
7.	Start pump	.092	"	.092
8.	Walk 10 ft. to homogenizer.	.126	"	.126
9.	Start homogenizer and raise pressure.	.268	"	.268
10.	Walk 25 ft. to vat.	.248	"	.248
11.	Turn off pump.	.056	"	.056
12.	Turn off steam on vat.	.058	"	.058
13.	Stop agitator.	.052	"	.052
14.	Open vat outlet valve.	.094	"	.094

Appendix A

Table A-16. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
15.	Walk 10 ft. to homogenizer.	.116	100%	.116
16.	Stop homogenizer.	.080	"	.080
17.	Walk 25 ft. to surface cooler.	.268	"	.268
18.	Turn off steam.	.116	"	.116
19.	Drain bottom trough.	.148	"	.148
20.	Walk 25 ft. to filler.	.254	"	.254
21.	Drain filler.	.186	"	.186
	Total Cycle Time			2.976

Performance Rating	80%
Allowances	20%
Total	100%

Table A-17. Dairy "A" Assembly and Disassembly of Sanitary Pipe and Fittings.

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Loosen pipe hex nuts with wrench.	.068	150%	.102
2.	Unscrew hex nuts by hand.	.133	"	.199
3.	Walk 30 ft. and get gaskets and return to vat.	.339	"	.508
4.	Pick up pipe.	.070	"	.105
5.	Place gasket.	.079	"	.118
6.	Pick up mating pipe and place.	.090	"	.135
7.	Screw hex nut by hand.	.141	"	.211
8.	Tighten hex nut with wrench.	.088	"	.132
9.	Walk to upper deck and get pipe section and return to wash vat - distance 30 ft.	.387	"	.580
10.	Carry pipe section to upper deck and return to wash vat - distance 30 ft.	.397	"	.595
11.	Walk 20 ft. to pipe section on lower floor and carry section to wash vat.	.257	"	.385
12.	Carry section 20 ft. from vat to assembly position on lower floor.	.286	"	.429
13.	Walk around assembled pipe to loosen and tighten - distance 140 ft.	1.10	"	1.65

Performance Rating	130%
Allowances	20%
Total	150%

Appendix A

Table A-18. Dairy "A" Washing of Sanitary Pipe and Fittings

This is a two man operation, with one man picking up the pipe and holding while the other man runs pipe brush through pipe. The pipe is then placed on pipe rack.

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Wash pipe sections from 6" to 2' in length.	.057	150%	.085
2.	Wash pipe sections from 2' to 4' in length.	.085	"	.127
3.	Wash pipe sections from 4' to 7' in length.	.130	"	.195
4.	Wash pipe sections from 7' to 10' in length.	.198	"	.297
5.	Wash ells.	.051	"	.076
6.	Wash tees.	.061	"	.091

Performance Rating	130%
Allowances	20%
Total	150%

Table A-19. Dairy "A" Preparing Buckets of Chlorine Solution

Element Number	Element Description	Actual Average time in Minutes	Rating	Allowed Time in Minutes
1.	Turn on water in hose and fill bucket.	.332	150%	.498
2.	Walk 5 ft. to chlorine jug.	.063	"	.094
3.	Pour chlorine in water.	.123	"	.184
	Total Cycle Time			.776

Performance Rating	130%
Allowances	20%
	150%

Table A-20. Dairy "A" Preparing Buckets of Washing Solution

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 10 ft. to get dipper of wash powder and return to hose.	.260	150%	.390

Appendix A

Table A-20. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
2.	Turn on hose and fill bucket.	.340	150%	.510
3.	Put powder in bucket.	.131	"	.196
	Total Cycle Time			1.096

Performance Rating	130%
Allowances	20%
Total	150%

Table A-21. Dairy "A" Filling and Emptying Wash Tank

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 5 ft. to hose.	.063	150%	.094
2.	Turn on water.	.051	"	.076
3.	Return with hose to vat.	.078	"	.117
4.	Fill vat with water.	1.52	"	2.280
5.	Return hose.	.070	"	.105
6.	Turn off water.	.073	"	.109
7.	Pull vat plug.	.047	"	.070
8.	Drain tank.	1.83	"	2.740
	Total Cycle Time			5.590

Performance Rating	130%
Allowances	20%
Total	150%

Table A-22. Dairy "A" Miscellaneous Pipe Washing Operations

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 10 ft. and get dipper of wash powder and return to tank.	.242	150%	.363
2.	Reach under tank and get chlorine jug and pour into vat.	.302	"	.453
3.	Take pipe from rack and place in vat.	1.21	"	1.810

Performance Rating	130%
Allowances	20%
Total	150%

Appendix B

Table B-1. Dairy "B" Weigh Tank

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove weigh tank cover.	.111	130%	.144
2.	Remove surge tank cover.	.170	"	.221
3.	Walk 10 ft. turn on hose and return to tank.	.270	"	.351
4.	Rinse weigh tank and surge tank.	1.900	"	2.470
5.	Remove dump grid.	.091	"	.118
6.	Remove dump screen.	.226	"	.293
7.	Rinse dump screen.	.773	"	1.004
8.	Walk 15 ft. get dipper of powder and return to tank, place powder in tank.	.357	"	.464
9.	Wash dump grid.	.843	"	1.095
10.	Wash dump screen.	3.33	"	4.320
11.	Wash weigh tank cover.	1.265	"	1.644
12.	Wash outside scale framework.	1.370	"	1.781
13.	Wash weigh tank.	4.440	"	5.772
14.	Wash inside surge tank.	1.44	"	1.870
15.	Wash outside surge tank.	1.226	"	1.593
16.	Wash splash guard.	.349	"	.453
17.	Wash surge tank cover.	1.633	"	2.122
18.	Rinse all parts.	5.177	"	6.730
19.	Walk 10 ft. turn off hose and return to tank.	.286	"	.371
20.	Replace weigh tank cover.	.188	"	.244
21.	Replace screen.	.115	"	.149
22.	Replace dump grid.	.161	"	.209
23.	Replace surge tank cover.	.162	"	.210
24.	Replace splash guard.	.178	"	.231
	Total Cycle Time			33.859

Performance Rating	110%
Allowances	20%
Total	130%

Appendix B

Table B-2. Dairy "B" Multiple Section Cabinet Cream Cooler

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Open cabinet.	.275	100%	.275
2.	Walk 15 ft. turn on water, return with hose to cooler.	.309	"	.309
3.	Rinse cooler.	2.710	"	2.710
4.	Walk 15 ft. return hose, turn off water, return to cooler.	.311	"	.311
5.	Walk 50 ft. get bucket of cleaning solution, return to cooler.	.864	"	.864
6.	Climb up on wash rack with bucket of solution and brushes.	.234	"	.234
7.	Remove top distribution trough.	.325	"	.325
8.	Wash inside left shield.	1.250	"	1.250
9.	Wash left side of first cooling section.	.751	"	.751
10.	Pull back section.	.108	"	.108
11.	Wash right side of first section.	.762	"	.762
12.	Wash left side of center section.	.753	"	.753
13.	Pull back section.	.107	"	.107
14.	Wash right side center section.	.753	"	.753
15.	Wash left side third section.	.760	"	.760
16.	Pull back section.	.116	"	.116
17.	Wash right side third section.	.754	"	.754
18.	Wash inside right shield.	1.243	"	1.243
19.	Wash bottom trough.	1.210	"	1.210
20.	Wash top trough.	1.430	"	1.430
21.	Climb down from rack.	.208	"	.208
22.	Walk 15 ft. turn on water, return with hose to cooler.	.304	"	.304
23.	Rinse cooler.	4.238	"	4.238
24.	Replace top distribution trough.	1.047	"	1.047
25.	Close cabinet.	.443	"	.443
26.	Wash outside cooler cabinet.	2.645	"	2.645
27.	Rinse outside cabinet.	1.279	"	1.279
28.	Walk 15 ft. return hose, turn off water, return to cooler.	.331	"	.331
	Total Cycle Time			25.519

Performance Rating	80%
Allowances	20%
Total	100%

Appendix B

Table B-3. Dairy "B" 1000 Gallon Square Milk Storage Tanks

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 15 ft. turn water on, return to tank with hose.	.386	100%	.386
2.	Rinse tank.	1.380	"	1.380
3.	Walk 15 ft. return hose, turn off water, return to tank.	.326	"	.326
4.	Walk 50 ft. get bucket of cleaning solution and return to tank.	.844	"	.844
5.	Climb into tank.	.289	"	.289
6.	Wash inside tank.	4.540	"	4.540
7.	Climb out of tank.	.115	"	.115
8.	Wash cover.	1.210	"	1.210
9.	Walk 15 ft. turn water on, return to tank with hose.	.363	"	.363
10.	Rinse tank.	1.680	"	1.680
11.	Walk 15 ft. turn off water, return to tank.	.346	"	.346
12.	Close cover.	.364	"	.364
	Total Cycle Time			11.846

Performance Rating	80%
Allowances	20%
Total	100%

Table B-4. Dairy "B" 100 Gallon Round Cream Pasteurizing Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 10 ft. turn water on, return to vat with hose.	.253	120%	.303
2.	Rinse vat.	1.580	"	1.896
3.	Walk 10 ft. return hose, turn off water, return to vat.	.244	"	.292
4.	Walk 40 ft. get bucket of cleaning solution and return to vat.	.747	"	.896
5.	Wash outside vat cover.	1.228	"	1.473
6.	Wash outside vat.	1.490	"	1.788
7.	Wash underside of vat cover.	1.150	"	1.380
8.	Wash inside vat.	5.367	"	6.440
9.	Walk 10 ft. turn on water, return to vat with hose.	.243	"	.291

Appendix B

Table B-4. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
10.	Rinse vat.	1.117	120%	1.340
11.	Walk 10 ft. return hose, turn off water, return to vat.	.267	"	.267
	Total Cycle Time			16.416

Performance Rating	100%
Allowances	20%
Total	120%

Table B-5. Dairy "B" 2000 Gallon Upright Milk Storage Tank

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Open manhole.	.337	120%	.404
2.	Walk 20 ft. turn on water, return to vat with hose.	.425	"	.510
3.	Rinse tank.	2.522	"	3.026
4.	Walk 50 ft. get bucket of cleaning solution and return to tank.	.882	"	1.058
5.	Climb into tank with bucket and brush.	.653	"	.783
6.	Wash tank.	3.712	"	4.454
7.	Climb out of tank.	.341	"	.409
8.	Wash manhole cover.	1.310	"	1.572
9.	Rinse tank.	1.266	"	1.519
10.	Walk 20 ft. turn off water, return to vat.	.387	"	.464
11.	Close manhole.	.536	"	.643
	Total Cycle Time			14.840

Performance Rating	100%
Allowances	20%
Total	120%

Appendix B

Table B-6. Dairy "B" 200 Gallon Rectangular Pasteurizing Vats

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 10 ft. turn water on in hose, return with hose to vat.	.265	110%	.291
2.	Rinse vat, leaving hose running in vat.	1.102	"	1.212
3.	Walk 15 ft. get dipper of cleaning powder, return and place powder in vat.	.322	"	.354
4.	Walk 15 ft. get bucket of cleaning solution and return to vat.	.340	"	.374
5.	Wash indicating thermometer.	.388	"	.426
6.	Wash stem of recording thermometer.	.542	"	.596
7.	Wash top of vat covers.	1.230	"	1.350
8.	Wash underside of vat covers.	.819	"	.901
9.	Wash inside vat, letting cleaning solution run out slowly.	12.386	"	13.620
10.	Wash outlet valve.	.828	"	.910
11.	Rinse vat.	1.652	"	1.817
12.	Walk 10 ft. to return hose, shut off water and return to vat.	.314	"	.345
13.	Close cover.	.122	"	.134
	Total Cycle Time			22.330

Performance Rating	90%
Allowances	20%
Total	110%

Table B-7. Dairy "B" 200 Gallon Round Butter Milk Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 10 ft. turn on water, return with hose to vat.	.264	140%	.369
2.	Rinse vat.	1.779	"	2.490
3.	Walk 10 ft. return hose, turn off water, return to vat.	.293	"	.410
4.	Walk 40 ft. get bucket of cleaning solution, return to vat.	.726	"	1.016

Appendix B

Table B-7. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
5.	Wash outside vat cover.	2.858	140%	4.001
6.	Wash outside vat.	5.925	"	8.295
7.	Wash underside vat cover.	2.840	"	3.970
8.	Wash inside vat.	3.475	"	4.860
9.	Disassemble outlet valve.	.121	"	.169
10.	Wash outlet valve.	1.113	"	1.558
11.	Walk 10 ft. turn on water, return with hose to vat.	.284	"	.397
12.	Rinse vat.	2.827	"	3.957
13.	Walk 10 ft. return hose, turn off water, return to vat.	.277	"	.387
14.	Assemble outlet valve.	.257	"	.359
	Total Cycle Time			32.200

Performance Rating	120%
Allowances	20%
Total	140%

Table B-8. Dairy "B" Clarifier

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove coupling nut.	.232	100%	.232
2.	Remove outlet connection, and supporting plate.	.349	"	.349
3.	Remove frame cover bolts and raise frame cover.	.434	"	.434
4.	Remove coupling ring.	.876	"	.876
5.	Walk 10 ft. turn on water, return with hose to clarifier.	.265	"	.265
6.	Force bowl up with water pressure.	.241	"	.241
7.	Remove coupling ring.	.842	"	.842
8.	Remove bowl top.	.123	"	.123
9.	Remove disc carrier and discs.	.436	"	.436
10.	Remove bowl lock nut.	.341	"	.341
11.	Remove bowl shell.	.661	"	.661
12.	Place discs on disc rack.	1.125	"	1.125
13.	Rinse all parts.	6.440	"	6.440
14.	Carry disc rack 40 ft. to wash tank.	.433	"	.433

Appendix B

Table B-8. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
15.	Wash disc on revolving brush. Average time for 1 disc is .12 - total discs 63.	7.560	100%	7.560
16.	Walk 40 ft. carry discs back to clarifier.	.427	"	.427
17.	Walk 30 ft. get bucket of cleaning solution, return to clarifier.	.525	"	.525
18.	Wash disc carrier.	.658	"	.658
19.	Wash bowl shell.	1.211	"	1.211
20.	Wash bowl rubber.	.127	"	.127
21.	Wash bowl top.	.733	"	.733
22.	Wash coupling ring.	.415	"	.415
23.	Wash outlet connection.	.411	"	.411
24.	Wash supporting plate.	.451	"	.451
25.	Wash coupling ring.	.341	"	.341
26.	Wash milk inlet assembly.	1.700	"	1.700
27.	Wash clarifier.	2.731	"	2.731
28.	Rinse all parts.	2.060	"	2.060
29.	Place parts on rack.	1.377	"	1.377
30.	Place bowl shell.	.339	"	.339
31.	Place bowl locking nut.	1.115	"	1.115
32.	Place disc carrier.	.243	"	.243
33.	Remove discs from disc rack.	.640	"	.640
34.	Place discs on disc carrier. Average time for 1 disc is .087 - total discs 63.	5.670	"	5.670
35.	Place bowl rubber.	.186	"	.186
36.	Place bowl top.	.245	"	.245
37.	Place coupling ring.	1.062	"	1.062
38.	Lower frame cover and lock.	.526	"	.526
39.	Place supporting plate and outlet connection.	.161	"	.161
40.	Place coupling nut.	.568	"	.568
41.	Assemble and place milk inlet connection.	1.238	"	1.238
42.	Walk 10 ft. return hose, turn off water, return to clarifier.	.254	"	.254
	Total Cycle Time			46.357

Performance Rating	80%
Allowances	20%
Total	100%

Appendix B

Table B-9. Dairy "B" Separator

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove milk and cream spouts.	.271	120%	.325
2.	Remove coupling ring.	.847	"	1.016
3.	Remove bowl top.	.258	"	.309
4.	Remove top disc.	.197	"	.236
5.	Remove disc carrier and discs.	.318	"	.381
6.	Remove bowl rubber.	.330	"	.396
7.	Remove bowl shell.	.349	"	.418
8.	Walk 10 ft. turn on water, return with hose to separator.	.261	"	.313
9.	Rinse all parts.	4.714	"	5.650
10.	Walk 10 ft. return hose, turn off water, return to separator.	.266	"	.319
11.	Walk 40 ft. get bucket of cleaning solution, return to separator.	.492	"	.590
12.	Wash outside separator frame.	1.846	"	2.215
13.	Wash bowl shell.	2.990	"	3.580
14.	Wash bowl top.	.781	"	.937
15.	Wash spout assembly.	2.096	"	2.510
16.	Wash top disc.	.836	"	1.003
17.	Wash disc carrier.	.749	"	.898
18.	Wash bowl rubber.	.249	"	.298
19.	Walk 50 ft. carry discs to wash tank.	.488	"	.585
20.	Wash discs on power brush. Average time for 1 disc is .08 - total discs 75.	6.010	"	7.210
21.	Walk 50 ft. carry discs back to separator.	.463	"	.555
22.	Walk 10 ft. turn on water, return to separator with hose.	.261	"	.313
23.	Rinse all parts.	2.470	"	2.964
24.	Walk 10 ft. return hose, turn off water, return to separator.	.261	"	.313
25.	Place bowl shell.	.260	"	.312
26.	Place disc carrier.	.264	"	.316
27.	Place discs. Average time for 1 disc is .05 - total discs 75.	3.750	"	4.500
28.	Place top disc.	.124	"	.148
29.	Place bowl rubber.	.267	"	.320
30.	Place bowl top.	.208	"	.249

Appendix B

Table B-9. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
31.	Place coupling ring.	1.205	120%	1.446
32.	Place milk and cream spouts.	.258	"	.309
	Total Cycle Time			40.934

Performance Rating	100%
Allowances	20%
Total	120%

Table B-10. Dairy "B" Multiple Section Cabinet Milk Cooler

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Open cabinet.	.255	110%	.280
2.	Walk 10 ft. turn on water, return to cooler with hose.	.245	"	.269
3.	Rinse cooler.	1.976	"	2.173
4.	Walk 10 ft. return hose, turn off water, return to cooler.	.270	"	.297
5.	Walk 40 ft. get bucket of cleaning solution, return to cooler.	.755	"	.830
6.	Remove top trough.	.123	"	.135
7.	Wash top trough.	1.620	"	1.782
8.	Wash inside left shield.	1.470	"	1.617
9.	Wash left side of first section.	.923	"	1.015
10.	Pull back section.	.121	"	.133
11.	Wash right side of first section.	.941	"	1.030
12.	Wash left side of second section.	.947	"	1.041
13.	Pull back section.	.120	"	.132
14.	Wash right side of second section.	.913	"	1.004
15.	Wash left side of third section.	.897	"	.986
16.	Pull back section.	.127	"	.139
17.	Wash right side of third section.	.938	"	1.031
18.	Wash left side of fourth section.	.918	"	1.009
19.	Pull back section.	.120	"	.132

Appendix B

Table B-10. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
20.	Wash right side of fourth section.	.899	110%	.988
21.	Wash left side of fifth section.	.940	"	1.034
22.	Pull back section.	.113	"	.124
23.	Wash right side of fifth section.	.940	"	1.034
24.	Wash left side of sixth section.	.931	"	1.024
25.	Wash right side of sixth section.	.940	"	1.034
26.	Wash bottom trough.	1.170	"	1.280
27.	Wash outside cabinet.	4.148	"	4.562
28.	Walk 10 ft. turn on water, return to cooler with hose.	.265	"	.291
29.	Rinse cooler.	8.550	"	9.405
30.	Walk 10 ft. return hose, turn off water, return to cooler.	.263	"	.289
31.	Replace top trough and close cabinet.	.867	"	.953
	Total Cycle Time			37.053

Performance Rating	90%
Allowances	20%
Total	110%

Table B-11. Dairy "B" Bottle Filler

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove shield.	.114	100%	.114
2.	Walk 30 ft. get 2 buckets of cleaning solution, return to filler.	.535	"	.535
3.	Remove vacuum assembly.	1.278	"	1.278
4.	Remove rubber vacuum seal.	.159	"	.159
5.	Remove filler cover.	.104	"	.104
6.	Disassemble level control float assembly.	.847	"	.847
7.	Remove filling rubbers and drip plates and place in bucket.	1.586	"	1.586

Appendix B

Table B-11. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
8.	Remove filling valves and place in bucket.	3.670	100%	3.670
9.	Walk 10 ft. turn on water, return to filler with hose.	.268	"	.268
10.	Rinse filler.	.867	"	.867
11.	Walk 10 ft return hose, turn off water, return to filler.	.255	"	.255
12.	Crank bowl down.	.528	"	.528
13.	Wash inside bowl.	2.160	"	2.160
14.	Wash bowl filling ports.	1.247	"	1.247
15.	Wash outside bowl.	1.730	"	1.730
16.	Wash lifter plates.	.744	"	.744
17.	Wash filler frame work.	4.350	"	4.350
18.	Wash star wheels.	2.228	"	2.228
19.	Wash 13 capping headers.	9.026	"	9.026
20.	Wash filling valves - 15 valves.	5.425	"	5.425
21.	Wash filling rubbers and drip plates.	1.054	"	1.054
22.	Wash level control float assembly.	.612	"	.612
23.	Wash vacuum assembly.	.915	"	.915
24.	Wash rubber vacuum seal.	.550	"	.550
25.	Wash bowl cover.	2.130	"	2.130
26.	Walk 10 ft. turn on water, return to filler with hose.	.267	"	.267
27.	Rinse filler.	7.283	"	7.283
28.	Walk 10 ft. return hose, turn off water, return to filler.	.266	"	.266
29.	Roll up bowl.	.377	"	.377
30.	Place filling valves in filler bowl.	4.140	"	4.140
31.	Place drip plates and filling rubbers.	2.808	"	2.808
32.	Roll down bowl.	.483	"	.483
33.	Place filler cover.	.246	"	.246
34.	Place rubber vacuum seal.	.749	"	.749
35.	Assemble level control assembly and place.	1.392	"	1.392
36.	Assemble vacuum assembly and place.	2.430	"	2.430
	Total Cycle Time			62.820

Performance Rating	80%
Allowances	20%
Total	100%

Appendix B

Table B-12. Dairy "B" Homogenizer

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 15 ft. turn on water, return with hose to homogenizer.	.355	150%	.532
2.	Circulate rinse homogenizer.	1.380	"	2.070
3.	Walk 15 ft. return hose, turn hose off, return to homogenizer.	.348	"	.522
4.	Walk 30 ft. get bucket of cleaning solution, return to homogenizer.	.569	"	.853
5.	Remove all hex nuts.	1.820	"	2.730
6.	Remove gage.	.134	"	.201
7.	Remove pressure control assembly.	.391	"	.586
8.	Remove manifold.	.443	"	.664
9.	Remove strainer.	.155	"	.232
10.	Remove port covers.	.325	"	.487
11.	Remove plunger rods.	2.268	"	3.402
12.	Remove packing glands.	1.164	"	1.746
13.	Remove suction and discharge valves.	.527	"	.790
14.	Wash block.	2.155	"	3.230
15.	Wash gage stem.	.138	"	.207
16.	Wash pressure control assembly.	2.280	"	3.420
17.	Wash manifold.	.446	"	.669
18.	Wash manifold strainer.	.265	"	.397
19.	Wash 3 plunger rods.	.516	"	.774
20.	Wash 3 packing glands.	1.384	"	2.076
21.	Wash suction and discharge valves.	.703	"	1.054
22.	Walk 15 ft. turn on water, return with hose to homogenizer.	.353	"	.529
23.	Rinse all parts.	1.278	"	1.917
24.	Walk 15 ft. return hose, turn off water, return to homogenizer.	.353	"	.529

Performance Rating	130%
Allowances	20%
Total	150%

Appendix B

Table B-12. (Continued) Assembly by Other Man

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
25.	Place suction and discharge valves.	1.123	100%	1.123
26.	Place 3 packing glands.	3.338	"	3.338
27.	Place 3 plunger rods.	1.708	"	1.708
28.	Place port covers.	.894	"	.894
29.	Assemble pressure control assembly and place.	.886	"	.886
30.	Place gauge.	.125	"	.125
31.	Place manifold and manifold strainer.	3.270	"	3.270
32.	Place all hex nuts and tighten.	4.251	"	4.251
	Total Cycle Time			45.212

Performance Rating	80%
Allowances	20%
Total	100%

Table B-13. Dairy "B" Centrifugal Milk Pump

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Disassemble pump.	.486	100%	.486
2.	Walk 15 ft. turn on water, return to pump with hose.	.339	"	.339
3.	Rinse pump.	.515	"	.515
4.	Walk 20 ft. get bucket of cleaning solution, return to pump.	.457	"	.457
5.	Wash back plate.	.348	"	.348
6.	Wash milk inlet and outlet housing.	.528	"	.528
7.	Wash impeller.	.250	"	.250
8.	Wash pump frame.	.257	"	.257
9.	Rinse pump.	.351	"	.351
10.	Walk 15 ft. return hose, turn off water, return to pump.	.328	"	.328
11.	Walk 30 ft. get pump gasket, return to pump.	.543	"	.543
12.	Assemble pump.	1.124	"	1.124
	Total Cycle Time			5.526

Performance Rating	80%
Allowances	20%
Total	100%

Appendix B

Table B-14. Dairy "B" Positive Displacement Pump

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove wing nuts.	.538	100%	.538
2.	Remove cover.	.164	"	.164
3.	Remove rotor shaft nuts.	.964	"	.964
4.	Remove rotors.	.176	"	.176
5.	Remove pump body.	.274	"	.274
6.	Walk 10 ft. turn on water, return with hose to pump.	.257	"	.257
7.	Rinse pump.	.261	"	.261
8.	Walk 40 ft. get bucket of cleaning solution, return to pump.	.738	"	.738
9.	Remove rotary seal nuts.	1.583	"	1.583
10.	Wash rotary seal springs.	.188	"	.188
11.	Wash rotors.	.657	"	.657
12.	Wash rotary seal rubbers and washers.	.365	"	.365
13.	Wash rotary seal nuts.	.874	"	.874
14.	Wash pump body.	.765	"	.765
15.	Wash pump cover.	.565	"	.565
16.	Wash pump frame work.	.449	"	.449
17.	Rinse pump parts.	.630	"	.630
18.	Walk 10 ft. return hose, turn off water, return to pump.	.251	"	.251
19.	Walk 30 ft. get pump gaskets, return to pump.	.551	"	.551
20.	Place rotary seal nuts.	1.697	"	1.697
21.	Place pump body.	.239	"	.239
22.	Place rotary seal washers.	.258	"	.258
23.	Place rotary seal springs.	.279	"	.279
24.	Place rotors.	1.640	"	1.640
25.	Place gasket.	.315	"	.315
26.	Place pump cover.	.129	"	.129
27.	Place wing nuts.	.750	"	.750
	Total Cycle Time			15.557

Performance Rating	80%
Allowances	20%
Total	100%

Appendix B

Table B-15. Dairy "B" Tubular Preheater

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Assemble pipe for circulatory cleaning, using preheater circulating system.	3.230	100%	3.230
2.	Walk 40 ft. get bucket of cleaning solution, return to preheater.	.723	"	.723
3.	Pour bucket of solution into circulating system.	1.112	"	1.112
4.	After 20 minutes, stop pump, loosen end port covers and drain solution.	2.990	"	2.990
5.	Open end ports.	.704	"	.704
6.	Remove gaskets with knife.	3.012	"	3.012
7.	Push long handled brush through 36 tubes.	4.716	"	4.716
8.	Walk 15 ft. turn on water, return with hose to preheater.	.327	"	.327
9.	Rinse preheater.	2.019	"	2.019
10.	Walk 15 ft. return hose, turn off water, return to preheater.	.338	"	.338
11.	Walk 10 ft. get gaskets, return to preheater.	.238	"	.238
12.	Place gaskets and close port covers.	2.160	"	2.160
	Total Cycle Time			21.569

Performance Rating	80%
Allowances	20%
	100%

Table B-16. Dairy "B" Making up Buckets of Cleaning Solution

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 10 ft. pick up bucket, dipper of wash powder and return to hose.	.341	100%	.341
2.	Turn on hose and fill bucket.	.422	"	.422
3.	Dump powder in bucket and mix.	.183	"	.183
	Total Cycle Time			.946

Performance Rating	80%
Allowances	20%
Total	100%

Appendix B

Table B-17. Dairy "B" Filling Wash Tanks

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 20 ft. turn on water, return with hose to tank.	.412	100%	.412
2.	Fill wash tank.	5.960	"	5.960
3.	Walk 20 ft. return hose, turn off water, return to tank.	.435	"	.435
4.	Walk 30 ft. get bucket of cleaning solution, return and pour solution in tank.	.574	"	.574
	Total Cycle Time			7.381

Performance Rating	80%
Allowances	20%
	100%

Table B-18. Dairy "B" Sterilizing Equipment

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 5 ft. turn on hose, return to weigh tank.	.163	150%	.244
2.	Fill weigh tank.	2.856	"	4.280
3.	Walk 5 ft. return hose, turn off water, return to tank.	.152	"	.228
4.	Walk 10 ft. get chlorine, return to tank, place chlorine in tank.	.303	"	.454
5.	Turn on pump, walk 70 ft. to homogenizer and start homogenizer.	.695	"	1.042
6.	Walk 15 ft. to pasteurizing vats.	.103	"	.154
7.	Splash chlorine solution on inside of vats.	5.496	"	8.240
8.	Drain entire system.	3.320	"	4.980
	Total Cycle Time			19.622

Performance Rating	130%
Allowances	20%
Total	150%

Appendix B

Table B-19. Dairy "B" Washing Sanitary Pipe and Fittings

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
	Pipe Lengths 6" to 2'			
1.	Pick up pipe and run brush through pipe.	.115	100%	.115
2.	Walk to end of vat and place pipe.	.091	"	.091
	Pipe Lengths 2' to 4'			
1.	Pick up pipe and run brush through pipe.	.172	"	.172
2.	Walk to end of vat and place pipe.	.105	"	.105
	Pipe Lengths 4' to 7'			
1.	Pick up pipe and run brush through pipe.	.237	"	.237
2.	Walk to end of vat and place pipe.	.132	"	.132
	Pipe Lengths 7' to 10'			
1.	Pick up pipe and run brush through pipe.	.340	"	.340
2.	Walk to end of vat and place pipe.	.156	"	.156
1.	Place all pipe on pipe rack in a definite position.	15.280	"	15.280
2.	Place all fittings and valves on pipe rack in a definite position.	7.710	"	7.710
1.	Pick up ell, run brush through, place ell at end of tank.	.158	"	.158
2.	Pick up tee, run brush through, place tee at end of vat.	.135	"	.135
	Washing Valves			
1.	Disassemble valve.	.217	"	.217
2.	Wash valve.	.401	"	.401
3.	Assemble valve.	.296	"	.296
	Performance Rating	80%		
	Allowances	20%		
	Total	100%		

Appendix B

Table B-20. Dairy "B" Assembly and Disassembly of Sanitary Pipe and Fittings

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Loosen pipe hex nuts with wrench.	.103	100%	.103
2.	Unscrew hex nuts by hand.	.185	"	.185
3.	Pick up pipe.	.108	"	.108
4.	Place gasket.	.112	"	.112
5.	Pick up mating pipe and place.	.123	"	.123
6.	Screw hex nut by hand.	.229	"	.229
7.	Tighten hex nut with wrench.	.121	"	.121
8.	Carry sections of pipe to wash tank - 60 trips - total ft. walked 1300.	15.046	"	15.046
9.	Carry sections of pipe from pipe rack to assembly location - 65 trips - total ft. walked 1420.	16.321	"	16.321
10.	Walk 300 ft. around assembled pipe to tighten and loosen hex nuts.	2.250	"	2.250

Performance Rating	80%
Allowances	20%
Total	100%

Appendix C

Table C-1. Dairy "C" Weigh Tank

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove right cover.	.120	130%	.156
2.	Remove left cover.	.117	"	.152
3.	Remove one section of dump guard.	.065	"	.084
4.	Remove other section of dump guard.	.065	"	.084
5.	Remove strainer.	.206	"	.267
6.	Walk 5 ft. turn on hose and return.	.232	"	.301
7.	Rinse weigh tank.	1.413	"	1.830
8.	Place hose in tank.	.106	"	.137
9.	Walk 60 ft. get wash powder and return.	.916	"	1.190
10.	Place powder in weigh tank.	.105	"	.136
11.	Wash inside and outside of weigh tank.	3.507	"	4.559
12.	Walk 5 ft. turn off water and return.	.207	"	.269
13.	Wash right cover.	.955	"	1.241
14.	Wash left cover.	.954	"	1.240
15.	Wash strainer.	2.704	"	3.515
16.	Wash one section of dump guard.	.417	"	.542
17.	Wash other section of dump guard.	.424	"	.551
18.	Wash sample port covers.	.228	"	.296
19.	Wash can washer drain.	1.249	"	1.623
20.	Wash dump rack.	.460	"	.598
21.	Wash scale frame.	.649	"	.843
22.	Walk 5 ft. turn on hose and return.	.240	"	.312
23.	Rinse weigh tank.	1.319	"	1.714
24.	Walk 5 ft. turn off water and return.	.225	"	.292
25.	Place strainer.	.144	"	.187
26.	Place dump guard.	.114	"	.148
27.	Place other half of guard.	.116	"	.150
28.	Place right cover.	.121	"	.157
29.	Place left cover.	.131	"	.170
	Total Cycle Time			22.744

Performance Rating	110%
Allowances	20%
Total	130%

Appendix C

Table C-2. Dairy "C" Homogenizer

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 10 ft. turn on water in hose and return to homogenizer.	.199	100%	.199
2.	Place hose in homogenizer port.	.096	"	.096
3.	Rinse homogenizer while running.	.527	"	.527
4.	Screw on cleaning solution pot.	.225	"	.225
5.	Make pipe connection to pot.	.347	"	.347
6.	Fill homogenizer and solution pot with water.	.793	"	.793
7.	Walk 10 ft. turn off hose, pick up dipper of powder and return to homogenizer.	.286	"	.286
8.	Place powder in pot.	.057	"	.057
9.	Turn pressure to 1000#, machine clean for 15 minutes.	.302	"	.302
10.	Break cleaning connection.	.112	"	.112
11.	Walk 10 ft. turn on hose and return to homogenizer.	.203	"	.203
12.	Place hose in pot.	.067	"	.067
13.	Circulate rinse.	.657	"	.657
14.	Wash outside homogenizer.	.354	"	.354
15.	Walk 10 ft. turn off hose and return to homogenizer.	.207	"	.207
16.	Turn off homogenizer and remove solution pot.	.173	"	.173
	Total Cycle Time			4.605

Performance Rating	80%
Allowances	20%
Total	100%

Appendix C

Table C-3. Dairy "C" 2500 Gallon Storage Tank

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Open manhole.	.206	140%	.288
2.	Disassemble outlet valve.	.152	"	.212
3.	Walk 15 ft. and turn on hose, return to tank.	.250	"	.350
4.	Rinse tank.	2.021	"	2.829
5.	Walk 15 ft. to hose valves.	.114	"	.159
6.	Fill bucket with water.	.106	"	.148
7.	Turn off water.	.070	"	.098
8.	Walk 5 ft. and get dipper of powder and return.	.126	"	.176
9.	Place powder in bucket.	.057	"	.079
10.	Carry bucket to tank - 15 ft., pick up brush on way.	.154	"	.215
11.	Wash outlet valve.	.871	"	1.219
12.	Wash inlet connection.	.531	"	.743
13.	Crawl into vat with bucket and brush.	.260	"	.364
14.	Wash inside of vat and manhole cover.	6.036	"	8.450
15.	Crawl out of vat.	.292	"	.408
16.	Walk 15 ft. turn on hose and return to tank.	.263	"	.368
17.	Rinse tank.	2.105	"	2.947
18.	Assemble outlet valve.	.240	"	.336
19.	Close manhole.	.885	"	1.239
20.	Walk 15 ft. turn off water and return to tank.	.276	"	.386
	Total Cycle Time			21.014

Performance Rating	120%
Allowances	20%
Total	140%

Table C-4. Dairy "C" 300 Gallon Round Pasteurizing Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove left cover.	.118	150%	.177
2.	Remove right cover.	.124	"	.186
3.	Remove stem thermometer.	.131	"	.196
4.	Remove agitator.	.157	"	.225
5.	Remove outlet plug valve.	.156	"	.234

Appendix C

Table C-4. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
6.	Walk 10 ft. to hose, pick up bucket, place dipper of cleaning powder in bucket, fill bucket with water.	.658	150%	.987
7.	Walk 10 ft. to vat.	.109	"	.163
8.	Climb in vat with bucket and brush.	.207	"	.310
9.	Wash inside of vat.	1.999	"	2.998
10.	Wash underside of center cover.	.297	"	.445
11.	Wash top center of cover.	.995	"	1.492
12.	Climb out of vat.	.181	"	.271
13.	Wash outside vat.	2.855	"	4.282
14.	Wash right cover.	.537	"	.805
15.	Wash left cover.	.557	"	.835
16.	Wash thermometer.	.127	"	.190
17.	Wash agitator.	.472	"	.708
18.	Wash outlet valve.	.177	"	.265
19.	Assemble outlet valve.	.328	"	.492
20.	Replace thermometer.	.096	"	.144
21.	Replace agitator.	.241	"	.361
22.	Walk 10 ft. turn on hose, return to vat.	.246	"	.369
23.	Rinse inside and outside vat.	2.019	"	3.028
24.	Walk 10 ft. turn off water, return to vat.	.248	"	.372
25.	Replace right cover.	.218	"	.329
26.	Replace left cover.	.234	"	.351
	Total Cycle Time			20.215
	Performance Rating	130%		
	Allowances	20%		
	Total	150%		

Table C-5. Dairy "C" 300 Gallon Square Coil Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Raise right cover.	.800	120%	.960
2.	Walk 5 ft. to other side of tank.	.820	"	.984
3.	Raise left cover.	.850	"	1.020
4.	Walk 10 ft. to hose, turn on water and return to vat.	.232	"	.278

Appendix C

Table C-5. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
5.	Rinse vat and fill bottom with water.	2.839	120%	3.406
6.	Walk 10 ft. turn off water and return to vat.	.240	"	.288
7.	Walk 15 ft. get dipper of powder, return to vat and place powder in vat.	.331	"	.397
8.	Wash inside of vat.	2.070	"	2.484
9.	Wash coil.	5.756	"	6.907
10.	Wash cover.	1.026	"	1.231
11.	Wash outside of tank.	3.089	"	3.706
12.	Disassemble outlet valve.	.124	"	.148
13.	Wash outlet valve.	.785	"	.942
14.	Assemble valve.	.248	"	.297
15.	Walk 10 ft. turn on water and return to vat.	.243	"	.291
16.	Rinse tank.	1.068	"	1.281
17.	Walk 10 ft. turn off water and return to vat.	.243	"	.291
	Total Cycle Time			24.911

Performance Rating	100%
Allowances	20%
Total	120%

Table C-6. Dairy "C" Positive Displacement Pump

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Loosen holding screws with mallet.	.538	100%	.538
2.	Remove screws.	.677	"	.677
3.	Remove outside plate housing.	.190	"	.190
4.	Pick up wrench and loosen upper and lower rotor nuts.	.569	"	.569
5.	Remove rotor nuts.	.803	"	.803
6.	Remove top rotor, spring, and packing ring.	.166	"	.166
7.	Remove lower rotor, spring, and packing ring.	.179	"	.179
8.	Wash outside plate housing.	.899	"	.899

Appendix C

Table C-6. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
9.	Wash top rotor.	.518	100%	.518
10.	Wash bottom rotor.	.535	"	.535
11.	Remove pump body.	.273	"	.273
12.	Remove rotary seal nut.	.646	"	.646
13.	Remove rotary seal nut.	.641	"	.641
14.	Wash back plate housing.	1.076	"	1.076
15.	Wash top packing ring.	.771	"	.771
16.	Wash bottom packing ring.	.764	"	.764
17.	Wash both back plate seal rings.	.452	"	.452
18.	Wash both springs.	.427	"	.427
19.	Wash rotor lock nuts and screws.	.462	"	.462
20.	Wash pump frame.	.724	"	.724
21.	Walk 10 ft. turn on water in hose, return hose to pump.	.266	"	.266
22.	Rinse pump.	.648	"	.648
23.	Walk 10 ft. return hose, turn off water, return to pump, picking up gaskets on way.	.383	"	.383
24.	Place gaskets and grease.	.808	"	.808
25.	Place top seal ring.	.532	"	.532
26.	Place bottom seal ring.	.541	"	.541
27.	Grease shafts.	.487	"	.487
28.	Place back plate.	.124	"	.124
29.	Grease top packing ring and place.	.545	"	.545
30.	Grease bottom packing ring and place.	.575	"	.575
31.	Push packing rings into place.	.826	"	.826
32.	Place top rotor and spring.	.255	"	.255
33.	Place rotor holding nut and tighten nut.	.741	"	.741
34.	Place bottom rotor and spring.	.269	"	.269
35.	Place bottom rotor holding nut and tighten nut.	.747	"	.747
36.	Grease outside plate housing seat.	1.842	"	1.842
37.	Walk 10 ft. get gasket and return.	.289	"	.289
38.	Place gasket.	.484	"	.484
39.	Place outside plate housing.	.263	"	.263
40.	Place plate holding screws.	1.149	"	1.149
41.	Tighten screws.	.460	"	.460
	Total Cycle Time			23.544

Performance Rating	80%
Allowances	20%
Total	100%

Appendix C

Table C-7. Dairy "C" Tubular Preheater

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Open end cover.	.177	120%	.212
2.	Open end cover.	.167	"	.200
3.	Remove both paper gaskets.	.246	"	.295
4.	Walk 10 ft. to other end of heater.	.113	"	.135
5.	Open end cover.	.159	"	.190
6.	Open end cover.	.168	"	.206
7.	Remove both paper gaskets.	.262	"	.314
8.	Walk 10 ft. to front of heater.	.123	"	.147
9.	Pick up brush rod.	.086	"	.103
10.	Dip brush in wash tank and run through tube - total 24 tubes.	5.850	"	7.020
11.	Pick up sponge and wash cover ports and return bends.	.466	"	.559
12.	Walk 10 ft. to other end of heater.	.133	"	.159
13.	Wash cover ports and return bends.	.490	"	.588
14.	Walk 20 ft. to hose, turn on water and return to heater.	.460	"	.552
15.	Rinse heater.	.414	"	.496
16.	Walk 20 ft. turn off water, return to heater.	.436	"	.523
17.	Walk 20 ft. and get gaskets, return to heater.	.505	"	.606
18.	Place both gaskets.	.204	"	.244
19.	Close ports and tighten.	.272	"	.326
20.	Walk 10 ft. to other end of heater.	.138	"	.165
21.	Place both gaskets.	.234	"	.280
22.	Close ports and tighten.	.253	"	.303
	Total Cycle Time			13.623

Performance Rating	100%
Allowances	20%
Total	120%

Appendix C

Table C-8. Dairy "C" Bottle Filler

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove float level control, carry 15 ft. to wash tank and return to filler.	.256	120%	.307
2.	Remove filler cover.	.120	"	.144
3.	Remove filling valve suction rubbers and place in bucket - 24 rubbers.	.185	"	.222
4.	Disassemble capping headers - 8 headers.	2.096	"	2.515
5.	Walk 15 ft. turn on hose and return to filler.	.261	"	.313
6.	Rinse filler.	1.801	"	2.161
7.	Rinse conveyer.	1.114	"	1.336
8.	Walk 15 ft. turn off water in hose and return to filler.	.269	"	.322
9.	Remove filling valves and place on rack - 24 valves.	2.610	"	3. 133
10.	Place valves in bucket.	.661	"	.793
11.	Walk 15 ft. to hose, turn on water and walk 30 ft. with hose to wash tank.	.431	"	.517
12.	Fill wash tank with water.	2.074	"	2.488
13.	Walk 15 ft. to filler.	.118	"	.141
14.	Fill 2 buckets with water.	.622	"	.746
15.	Walk 15 ft. return hose, shut off water and return to filler.	.268	"	.321
16.	Walk 15 ft. to cupboard and get dipper of wash powder and return to filler.	.287	"	.344
17.	Place handful of wash powder in each bucket.	.093	"	.111
18.	Walk 15 ft. to wash tank and place wash powder in tank.	.161	"	.193
19.	Wash float.	.280	"	.336
20.	Wash float cover.	.279	"	.334
21.	Wash float inlet tube.	.184	"	.220
22.	Walk 15 ft. to filler.	.123	"	.147
23.	Wash cap chute.	.512	"	.614
24.	Wash filler cover.	.828	"	.993
25.	Pour bucket of solution on capping headers.	.466	"	.559
26.	Put bucket of solution in filler bowl.	.111	"	.133
27.	Wash filler valve ports - inside	1.134	"	1.360
28.	Wash inside bowl.	1.172	"	1.406
29.	Wash outside bowl.	.494	"	.592

Appendix C

Table C-8. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
30.	Wash outside valve ports.	1.191	120%	1.429
31.	Wash cap feed.	.432	"	.518
32.	Wash bottle conveyer guards and guides.	.871	"	1.045
33.	Wash bottle assembly table, lifter plates, motor cover and filler frame.	5.861	"	7.033
34.	Wash star wheels.	1.062	"	1.274
35.	Disassemble filling valves, wash all parts, assemble valves, place in bucket - 24 valves.	8.660	"	10.392
36.	Place all valves on rack.	.926	"	1.111
37.	Rinse filler, conveyers, filling valves and frame work.	4.746	"	5.695
38.	Walk 15 ft. and get hose with boiling water and return to filler.	.278	"	.333
39.	Walk 15 ft. return hose and shut off water.	.172	"	.205
	Assembly			
40.	Walk 15 ft. turn on boiling water in hose and return with hose to filler.	.279	"	.334
41.	Sterilize filler.	3.123	"	3.747
42.	Walk 15 ft. turn off water and return to filler.	.278	"	.333
43.	Place valves, springs and clips in filler bowl and assemble valves.	3.231	"	3.877
44.	Place valves in filler - 24 valves.	2.680	"	3.216
45.	Place headers and assemble - 8 headers.	4.800	"	5.760
46.	Place cover.	.106	"	.127
47.	Assemble float.	.456	"	.547
48.	Place float.	.163	"	.195
49.	Place filling rubbers on valves.	1.040	"	1.248
	Total Cycle Time			71.221

Performance Rating 100%
Allowances 20%
Total 120%

Appendix C

Table C-9. Dairy "C" 500 Gallon Round Pasteurizing Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 20 ft. turn on water, return to vat with hose.	.412	150%	.618
2.	Rinse vat.	1.400	"	2.100
3.	Walk 20 ft. return hose, turn off water, return to vat.	.431	"	.646
4.	Walk 30 ft. get bucket of cleaning solution, return to vat.	.573	"	.859
5.	Climb into vat.	.250	"	.375
6.	Wash underside of cover.	.907	"	1.360
7.	Wash inside vat.	1.503	"	2.254
8.	Climb out of vat.	.273	"	.409
9.	Wash outside vat.	2.107	"	3.160
10.	Disassemble outlet valve.	.412	"	.618
11.	Wash outlet valve.	.552	"	.828
12.	Assemble outlet valve.	.536	"	.804
13.	Walk 20 ft. turn on water, return to vat with hose.	.407	"	.610
14.	Rinse vat.	1.150	"	1.725
15.	Walk 20 ft. return hose, turn off water, return to vat.	.426	"	.639
	Total Cycle Time			17.005

Performance Rating	130%
Allowances	20%
Total	150%

Table C-10. Dairy "C" 1000 Gallon Upright Milk Storage Tank

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 15 ft. turn on water, return to tank with hose.	.361	110%	.397
2.	Climb in tank with hose and brush.	.303	"	.333
3.	Wash inside tank with clear water and brush.	6.504	"	7.150
4.	Climb out of tank.	.331	"	.364
5.	Wash outside tank.	2.403	"	2.643
6.	Wash dump connection.	1.507	"	1.657

Appendix C

Table C-10. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
7.	Rinse tank.	2.571	110%	2.828
8.	Walk 15 ft. return hose, turn off water, return to tank.	.354	"	.389
	Total Cycle Time			15.761

Performance Rating	90%
Allowances	20%
Total	110%

Table C-11. Dairy "C" Vertical Coil Round Pasteurizing Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 5 ft. turn on water, return with hose to vat.	.193	150%	.289
2.	Rinse vat.	.523	"	.784
3.	Walk 5 ft. return hose, turn off water, return to vat.	.187	"	.280
4.	Walk 15 ft. get bucket of cleaning solution and return to vat.	.331	"	.496
5.	Wash inside vat.	1.803	"	2.704
6.	Wash vertical coil.	7.030	"	10.540
7.	Wash underside of cover.	.753	"	1.129
8.	Wash thermometer stem.	.450	"	.675
9.	Wash outside of vat.	3.401	"	5.100
10.	Disassemble, wash, and assemble outlet valve.	2.150	"	3.225
11.	Walk 5 ft. turn on water, return to vat with hose.	.183	"	.274
12.	Rinse vat.	1.807	"	2.710
13.	Walk 5 ft. return hose, turn off water, return to vat.	.196	"	.294
	Total Cycle Time			28.495

Performance Rating	130%
Allowances	20%
Total	150%

Appendix C

Table C-12. Dairy "C" 1000 Gallon Cottage Cheese Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 25 ft. turn on water, return to vat with hose.	.481	150%	.721
2.	Rinse vat.	4.901	"	7.351
3.	Wash inside of vat with water and metal sponge.	5.813	"	8.719
4.	Wash outside of vat.	1.503	"	2.254
5.	Wash cheese rake, strainer, funnel, and scoop.	2.197	"	3.295
6.	Rinse vat.	1.031	"	1.546
7.	Walk 25 ft. return hose, turn off water and return to vat.	.493	"	.739
	Total Cycle Time			24.625

Performance Rating	130%
Allowances	20%
Total	150%

Table C-13. Dairy "C" 800 Gallon Cottage Cheese Vat

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 20 ft. turn on water, return to vat with hose.	.392	150%	.588
2.	Rinse vat.	2.970	"	4.455
3.	Wash inside of vat with water and metal sponge.	4.507	"	6.760
4.	Wash outside of vat.	1.051	"	2.320
5.	Wash cheese rake, strainer, funnel, and scoop.	2.253	"	3.379
6.	Rinse vat.	.831	"	1.246
7.	Walk 20 ft. return hose, turn off water, return to vat.	.413	"	.619
	Total Cycle Time			19.367

Performance Rating	130%
Allowances	20%
Total	150%

Appendix C

Table C-14. Dairy "C" Surface Cooler

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 20 ft. turn on water, return to cooler with hose.	.437	150%	.655
2.	Place hose in distributor pipe, allowing water to run over cooler.	.563	"	.844
3.	Wash cooling section.	3.816	"	5.720
4.	Wash bottom trough.	1.950	"	2.925
5.	Rinse cooler.	1.040	"	1.560
6.	Walk 20 ft. return hose, turn off water and return to cooler.	.443	"	.664
	Total Cycle Time			12.360

Performance Rating	130%
Allowances	20%
Total	150%

Table C-15. Dairy "C" 40 Gallon Surge Tank for H.T.S.T. Pasteurizer.

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 15 ft. turn on water, return to tank with hose.	.237	150%	.355
2.	Rinse tank.	.153	"	.229
3.	Walk 15 ft. return hose, turn off water, return to tank.	.241	"	.361
4.	Walk 25 ft. get bucket of cleaning solution and return to tank.	.503	"	.754
5.	Wash tank cover.	.250	"	.375
6.	Wash inside tank.	.621	"	.931
7.	Wash outside tank.	1.246	"	1.870
8.	Walk 15 ft. turn on water, return to tank with hose.	.244	"	.366
9.	Rinse tank.	.457	"	.685
10.	Walk 15 ft. return hose, turn off water, return to tank.	.252	"	.378
	Total Cycle Time			6.304

Performance Rating	130%
Allowances	20%
Total	150%

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Appendix C

Table C-16. Dairy "C" Multiple Section Cabinet Cooler

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Open cabinet.	1.031	120%	1.237
2.	Remove brine and water headers.	1.361	"	1.633
3.	Walk 10 ft. turn on water, return to cooler with hose.	.234	"	.280
4.	Rinse cooler.	2.307	"	2.768
5.	Walk 10 ft. return hose, turn off water, return to cooler.	.243	"	.291
6.	Walk 20 ft. get bucket of cleaning solution, return to cooler.	.397	"	.476
7.	Wash inside of left shield.	.401	"	.481
8.	Wash left side of first section.	.613	"	.735
9.	Pull back section.	.153	"	.183
10.	Wash right side of first section.	.631	"	.757
11.	Wash left side of second section.	.596	"	.715
12.	Pull back section.	.146	"	.175
13.	Wash right side of second section.	.649	"	.778
14.	Wash left side of center section.	.619	"	.742
15.	Wash inside of right shield.	.421	"	.505
16.	Wash right side of fifth section.	.603	"	.723
17.	Pull back section.	.156	"	.187
18.	Wash left side of fifth section.	.634	"	.760
19.	Wash right side of fourth section.	.629	"	.754
20.	Pull back section.	.148	"	.177
21.	Wash left side, fourth section.	.628	"	.753
22.	Wash top trough.	1.421	"	1.705
23.	Wash bottom trough.	1.341	"	1.609
24.	Wash outside cooler.	2.153	"	2.580
25.	Walk 10 ft. turn on water, return to cooler with hose.	.257	"	.308
26.	Rinse cooler.	2.506	"	4.207
27.	Walk 10 ft. turn off water, return to cooler.	.267	"	.320
28.	Replace brine and water headers.	4.060	"	4.872

Appendix C

Table C-16. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
29.	Replace top trough.	.479	120%	.574
30.	Close cabinet.	1.460	"	1.752
	Total Cycle Time			33.039

Performance Rating 100%
Allowances 20%
Total 120%

Table C-17. Dairy "C" Clarifier

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove coupling nut.	.153	150%	.229
2.	Remove outlet connection and supporting plate.	.229	"	.343
3.	Raise frame cover.	.251	"	.376
4.	Remove bowl coupling ring.	.864	"	1.290
5.	Remove bowl top.	.110	"	.165
6.	Remove milk inlet assembly.	.407	"	.610
7.	Remove disc carrier and discs.	.301	"	.451
8.	Remove bowl locking nut and bowl shell.	.813	"	1.210
9.	Walk 15 ft. turn on water, return to clarifier with hose.	.336	"	.504
10.	Rinse all parts.	3.324	"	4.986
11.	Walk 15 ft. return hose, turn off water.	.362	"	.543
12.	Place all parts in wash tank.	.371	"	.556
13.	Wash bowl top.	1.403	"	2.104
14.	Wash bowl coupling ring.	.153	"	.229
15.	Wash coupling nut.	.141	"	.211
16.	Wash bowl shell.	1.611	"	2.416
17.	Wash bowl rubber.	.257	"	.385
18.	Wash inlet connection.	.341	"	.511
19.	Wash supporting plate.	.314	"	.471
20.	Wash disc carrier.	.951	"	1.420
21.	Wash discs. Average time for 1 disc is .06 - total discs - 83.	4.981	"	7.470
22.	Place discs on disc rack.	.143	"	.214
23.	Disassemble and wash milk inlet assembly.	1.062	"	1.590

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Table C-17. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
24.	Wash clarifier frame work.	.713	150%	1.069
25.	Walk 15 ft. turn on water, return to clarifier with hose.	.314	"	.471
26.	Rinse all parts.	2.416	"	3.624
27.	Raise frame cover.	.107	"	.160
28.	Place bowl shell.	.203	"	.304
29.	Tighten holding screws and place bowl lock nut.	.423	"	.634
30.	Place disc carrier.	.151	"	.221
31.	Remove discs from disc rack.	.223	"	.334
32.	Place discs on disc carrier. Average time for 1 disc is .03 - total discs 83.	2.490	"	3.735
33.	Place bowl rubber.	.103	"	.154
34.	Place bowl top.	.201	"	.301
35.	Place bowl coupling ring.	.753	"	1.129
36.	Lower frame cover.	.102	"	.153
37.	Tighten frame cover lock screws.	.357	"	.535
38.	Place supporting plate.	.107	"	.160
39.	Place milk outlet connection.	.253	"	.379
40.	Place coupling nut.	.201	"	.301
41.	Assemble milk inlet connection.	.203	"	.304
42.	Place milk inlet connection.	.156	"	.234
	Total Cycle Time			42.486

Performance Rating	130%
Allowances	20%
Total	150%

Table C-18. Dairy "C" Separator

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Remove milk inlet assembly and disassemble.	.834	120%	1.010
2.	Remove control valve head.	.374	"	.448
3.	Remove valve body.	.224	"	.268
4.	Remove valve seat disc.	.061	"	.073
5.	Remove coupling nut.	.223	"	.267
6.	Remove coupling ring.	.291	"	.349
7.	Remove cream outlet.	.102	"	.122
8.	Remove cream control base.	.093	"	.111

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Table C-18. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
9.	Remove skim milk outlet.	.112	120%	.134
10.	Remove cream seal.	.051	"	.061
11.	Remove check valve.	.063	"	.075
12.	Remove reinforcing cup and outlet seal.	.099	"	.123
13.	Raise frame cover.	.185	"	.222
14.	Remove bowl ring.	.653	"	.783
15.	Remove bowl top and top disc.	.183	"	.218
16.	Remove disc carrier and discs.	.293	"	.351
17.	Remove bowl locking nut.	.201	"	.241
18.	Remove bowl shell.	.292	"	.350
19.	Walk 25 ft. turn on water, return to separator with hose.	.491	"	.589
20.	Rinse separator parts.	3.612	"	4.335
21.	Wash separator frame with with brush and water.	3.571	"	4.285
22.	Walk 25 ft. return hose, turn off water, return to separator.	.509	"	.610
23.	Carry parts to wash tank - 5 trips - total 100 ft. walked.	1.173	"	1.407
24.	Wash valve body.	.151	"	.181
25.	Wash valve stem.	.132	"	.158
26.	Wash coupling nut.	.102	"	.122
27.	Wash coupling ring.	.113	"	.135
28.	Wash cream control base.	.216	"	.259
29.	Wash milk outlet.	.291	"	.349
30.	Wash cream seal.	.161	"	.193
31.	Wash reinforcing cup and seal.	.132	"	.158
32.	Wash bowl top.	1.391	"	1.669
33.	Wash top disc.	.493	"	.591
34.	Wash disc carrier.	1.162	"	1.394
35.	Wash bowl shell.	1.173	"	1.407
36.	Wash bowl rubber.	.296	"	.355
37.	Wash milk inlet assembly.	1.291	"	1.549
38.	Wash discs. Average time for 1 disc is .20 - total discs 124.	24.804	"	29.764
39.	Walk 5 ft. turn on water, return to wash tank with hose.	.173	"	.207
40.	Rinse all parts.	2.103	"	2.523
41.	Walk 5 ft. return hose, turn off water, return to tank.	.189	"	.226
42.	Carry parts to separator - 7 trips - total 140 ft. walked.	1.773	"	2.127

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Table C-18. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
43.	Place bowl shell.	.331	120%	.397
44.	Place bowl lock nut.	.391	"	.469
45.	Place disc carrier.	.153	"	.183
46.	Place discs. Average time for 1 disc is .05 - total discs 124.	6.203	"	7.443
47.	Place top disc.	.113	"	.135
48.	Place bowl rubber.	.153	"	.183
49.	Place bowl top.	.213	"	.255
50.	Place bowl coupling ring.	.907	"	1.088
51.	Lower frame cover.	.209	"	.250
52.	Place reinforcing cup and seal.	.163	"	.195
53.	Place milk outlet.	.241	"	.289
54.	Place cream seal and check valve.	.231	"	.277
55.	Place cream control base.	.196	"	.235
56.	Place coupling nut.	.103	"	.123
57.	Place valve body.	.213	"	.255
58.	Place valve stem.	.106	"	.127
59.	Place control valve head.	.316	"	.379
60.	Assemble and place milk inlet assembly.	1.931	"	2.317
	Total Cycle Time			74.443

Performance Rating	100%
Allowances	20%
Total	120%

Table C-19. Dairy "C" Raw Milk Plate Cooler

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Loosen press.	1.809	140%	2.532
2.	Walk 10 ft. turn on hose, fill bucket with water, turn off hose.	.428	"	.599
3.	Walk 5 ft. pick up dipper of wash powder, return to bucket, place powder in bucket.	.229	"	.320

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Table C-19. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
4.	Pick up bucket and brush and return 10 ft. to press.	.122	140%	.170
5.	Wash one side of first plate, pull back plate, wash other side of plate. Average time - 1 plate is .125 - total plates 144.	29.088	"	40.722
6.	Walk 10 ft. turn on hose, return to press.	.263	"	.368
7.	Rinse plates.	.829	"	1.160
8.	Walk 10 ft. turn off hose, return to press.	.259	"	.362
9.	Tighten press.	2.422	"	3.390
	Total Cycle Time			49.623

Performance Rating 120%
Allowances 20%
Total 140%

Table C-20. Dairy "C" Centrifugal Milk Pump

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Disassemble pump.	.510	100%	.510
2.	Walk 30 ft. get bucket of cleaning solution, return to pump.	.589	"	.589
3.	Walk 20 ft. turn on water, return with hose.	.443	"	.443
4.	Rinse pump.	.527	"	.527
5.	Wash milk inlet and outlet housing.	.612	"	.612
6.	Wash back plate.	.381	"	.381
7.	Wash impeller.	.226	"	.226
8.	Wash pump frame.	.362	"	.362
9.	Rinse pump.	.461	"	.461
10.	Walk 20 ft. return hose, turn off water, return to pump.	.472	"	.472
11.	Walk 25 ft. pick up gasket, return to pump.	.516	"	.516
12.	Assemble pump.	1.294	"	1.294
	Total Cycle Time			6.393

Performance Rating 80%
Allowances 20%
Total 100%

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Table C-21. Dairy "C" High Temperature Short Time Pasteurizer

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 10 ft. turn on water, return to pasteurizer with hose.	.279	100%	.279
2.	Place hose in surge tank and circulate rinse pasteurizer.	5.360	"	5.360
3.	Carry hose 15 ft. and place in circulating cleaning tank.	.203	"	.203
4.	Fill tank with water.	3.113	"	3.113
5.	Walk 20 ft. return hose, turn off water, return to pasteurizer.	.461	"	.461
6.	Connect circulating system.	2.651	"	2.651
7.	Walk 30 ft. pick up jar of acid cleaning powder, return to circulating unit.	.634	"	.634
8.	Place powder in circulating tank and mix solution.	1.031	"	1.031
9.	Turn on circulating pump, circulation time about 20 minutes.	.153	"	.153
10.	Walk 20 ft. turn on water, return to circulating tank with hose.	.473	"	.473
11.	Hold hose in tank until solution runs clear.	3.561	"	3.561
12.	Walk 20 ft. return hose, turn off water, return to tank.	.451	"	.451
13.	Walk 20 ft. pick up jar of alkali, return to circulating unit.	.612	"	.612
14.	Place powder in circulating unit and mix solution - circulating time - 20 minutes.	.984	"	.984
15.	Walk 20 ft. turn on water, return to tank with hose.	.483	"	.483
16.	Hold hose in tank until solution runs clear.	4.056	"	4.056
17.	Walk 20 ft. return hose, turn off water, return to tank.	.496	"	.496
18.	Disconnect circulating system.	2.364	"	2.364
19.	Loosen press.	1.753	"	1.753
20.	Pull back plates.	1.670	"	1.670
21.	Remove and disassemble flow diversion value.	.757	"	.757

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Table C-21. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
22.	Walk 15 ft. get bucket of solution and return to pasteurizer.	.341	100%	.341
23.	Wash flow diversion valve.	2.970	"	2.970
24.	Walk 20 ft. turn on water, return with hose to press.	.503	"	.503
25.	Wash one side of plate, pull back plate, wash other side, rinse plate. Average time for 1 plate is .613 - total plates 72.	44.136	"	44.136
26.	Wash press frame work.	2.460	"	2.460
27.	Rinse frame work.	1.614	"	1.614
28.	Walk 20 ft. return hose, turn off water, return to press.	.463	"	.463
29.	Assemble and place flow diversion valve.	1.643	"	1.643
30.	Close press and tighten.	3.062	"	3.062
	Total Cycle Time			88.764

Performance Rating	80%
Allowances	20%
Total	100%

Table C-22. Dairy "C" Preparing Buckets of Cleaning Solution

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 15 ft. get dipper of cleaning powder, return to hose.	.361	100%	.361
2.	Turn on hose and fill bucket.	.476	"	.476
3.	Place powder in bucket and mix.	.234	"	.234
	Total Cycle Time			1.071

Performance Rating	80%
Allowances	20%
Total	100%

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Table C-23. Dairy "C" Sterilizing Equipment

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 20 ft. turn on water, return to short time pasteurizer, place hose in surge tank.	.436	100%	.436
2.	Turn on circulating pump.	.153	"	.153
3.	Walk to homogenizer and turn on.	.721	"	.721
4.	Circulate 170 degree water through system and to bottle filler.	7.103	"	7.103
5.	Walk 20 ft. return hose, turn off water.	.448	"	.448
6.	Drain system.	2.105	"	2.105
	Total Cycle Time			10.966

Performance Rating	80%
Allowances	20%
Total	100%

Table C-24. Dairy "C" Filling Small Wash Tank

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 10 ft. turn on water, return with hose to tank.	.273	100%	.273
2.	Fill tank.	2.051	"	2.051
3.	Walk 10 ft. return hose, turn off water, return to tank.	.289	"	.289
4.	Walk 20 ft. get jar of wash powder, return to tank.	.432	"	.432
5.	Place powder in tank and mix.	.524	"	.524
	Total Cycle Time			3.569

Performance Rating	80%
Allowances	20%
Total	100%

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Table C-25. Dairy "C" Filling Large Wash Tank

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Walk 15 ft. turn on water, return with hose to wash tank.	.374	100%	.374
2.	Fill tank.	4.631	"	4.631
3.	Walk 15 ft. return hose, turn off water, return to tank.	.381	"	.381
4.	Walk 25 ft. get jar of wash powder, return to tank.	.513	"	.513
5.	Place powder in tank and mix solution.	.416	"	.416
	Total Cycle Time			6.315

Performance Rating	80%
Allowances	20%
	100%

Table C-26. Dairy "C" 2" Valves

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Disassemble valve.	.110	150%	.165
2.	Wash valve.	.550	"	.800
3.	Assemble valve.	.210	"	.315
	Total Cycle Time			1.275

Performance Rating	130%
Allowances	20%
Total	150%

Table C-27. Dairy "C" $1\frac{1}{2}$" Valves

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Disassemble valve.	.224	100%	.224
2.	Wash valve.	.416	"	.416
3.	Assemble valve.	.301	"	.301
	Total Cycle Time			.941

Performance Rating	80%
Allowances	20%
Total	100%

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Table C-28. Dairy "C" Assembly and Disassembly of 2" Pipe at Short Time Pasteurizer

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Loosen hex nut with wrench.	.130	100%	.130
2.	Unscrew hex nut by hand.	.197	"	.197
3.	Pick up pipe.	.122	"	.122
4.	Place gasket.	.107	"	.107
5.	Pick up mating pipe and place.	.143	"	.143
6.	Screw hex nut by hand.	.221	"	.221
7.	Tighten hex nut with wrench.	.108	"	.108
8.	Carry sections of pipe to wash tank - 30 trips - ft. walked 600.	6.370	"	6.370
9.	Carry sections of pipe from wash tank to pipe rack - 60 trips - ft. walked 1200.	13.375	"	13.375
10.	Carry sections of pipe from pipe rack to assembly position - 40 trips - ft. walked 800.	9.240	"	9.240
11.	Walk 10 ft. turn on water, return to pipe rack with hose.	.278	"	.278
12.	Rinse pipe.	4.674	"	4.674
13.	Walk 10 ft. return hose, turn off water, return to rack.	.284	"	.284
14.	Walk 80 ft. around assembly to tighten and loosen hex nuts.	.706	"	.706

Performance Rating	80%
Allowances	20%
Total	100%

Table C-29. Dairy "C" Washing 2" Pipe and Fittings at Short Time Pasteurizer

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
	Pipe Lengths 6" to 2'			
1.	Pick up pipe and run brush through pipe.	.131	100%	.131
2.	Wash outside of pipe.	.103	"	.103

Appendix C

Table C-29. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
	Pipe Lengths 2' to 4'			
1.	Pick up pipe and run brush through pipe.	.191	100%	.191
2.	Wash outside of pipe.	.213	"	.213
	Pipe Lengths 4' to 7'			
1.	Pick up pipe and run brush through pipe.	.271	"	.271
2.	Wash outside of pipe.	.413	"	.413
	Pipe Lengths 7' to 10'			
1.	Pick up pipe and run brush through pipe.	.415	"	.415
2.	Wash outside of pipe.	.532	"	.532
	3" Short Time Holding Tube			
1.	Disassemble tube.	4.401	"	4.401
2.	Wash tube.	5.321	"	5.321
3.	Assemble tube.	6.412	"	6.412
1.	Pick up ell, run brush through, place on rack.	.174	"	.174
2.	Pick up tee, run brush through, place on rack.	.179	"	.179
	Performance Rating 80%			
	Allowances 20%			
	Total 100%			

Dairy "C" Wash 1½" Sanitary Pipe and Fittings - Table C-30.

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
	Pipe Lengths 6" to 2'			
1.	Pick up pipe and run brush through pipe.	.128	100%	.128
2.	Wash outside of pipe.	.090	"	.090

Appendix C

Table C-30. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
	Pipe Lengths 2' to 4'			
1.	Pick up pipe and run brush through pipe.	.184	100%	.184
2.	Wash outside of pipe.	.207	"	.207
	Pipe Lengths 4' to 7'			
1.	Pick up pipe and run brush through pipe.	.256	"	.256
2.	Wash outside of pipe.	.364	"	.364
	Pipe Lengths 7' to 10'			
1.	Pick up pipe and run brush through pipe.	.389	"	.389
2.	Wash outside of pipe.	.476	"	.476
1.	Pick up ell, run brush through, place on drain board.	.163	"	.163
2.	Pick up tee, run brush through, place on drain board.	.158	"	.158
3.	Pick up cap, wash, place on drain board.	.083	"	.083
	Performance Rating	80%		
	Allowances	20%		
	Total	100%		

Table C-31. Dairy "C" Assembly and Disassembly $1\frac{1}{2}$" Sanitary Pipe and Fittings

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
1.	Loosen hex nut with wrench.	.124	100%	.124
2.	Unscrew hex nut by hand.	.191	"	.191
3.	Pick up pipe.	.113	"	.113
4.	Place gasket.	.102	"	.102
5.	Pick up mating pipe and place.	.130	"	.130
6.	Screw hex nut by hand.	.213	"	.213
7.	Tighten hex nut with wrench.	.102	"	.102

Appendix C

Table C-31. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
8.	Carry sections of pipe to wash tank - 29 trips - total ft. walked 600.	6.102	100%	6.102
9.	Carry sections of pipe from wash tank to pipe rack - 15 trips - total ft. walked 350.	3.710	"	3.710
10.	Walk 15 ft. turn on hose, return with hose to pipe rack.	.347	"	.347
11.	Rinse pipe.	2.156	"	2.156
12.	Walk 15 ft. return hose, turn off water, return to pipe rack.	.361	"	.361
13.	Carry sections of pipe from pipe rack to assembly area - 25 trips - total ft. walked 300.	3.261	"	3.261
14.	Walk 100 ft. around pipe to tighten and loosen hex nuts.	.864	"	.864

Performance Rating	80%
Allowances	20%
Total	100%

Table C-32. Dairy "C" 2" Pipe Washed on Power Driven Brush

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
	Pipe Lengths 6" to 2'			
1.	Pick up pipe from tank and move back into position.	.061	100%	.061
2.	Run pipe over revolving brush.	.054	"	.054
3.	Wash outside of pipe with sponge.	.121	"	.121
4.	Pull pipe off brush and place on pipe rack.	.102	"	.102
	Pipe Lengths 2' to 4'			
1.	Pick up pipe from tank and move back into position.	.073	"	.073
2.	Run pipe over revolving brush.	.071	"	.071

Appendix C

Table C-32. (Continued)

Element Number	Element Description	Actual Average Time in Minutes	Rating	Allowed Time in Minutes
3.	Wash outside of pipe with sponge.	.352	100%	.352
4.	Pull pipe off brush and place on pipe rack.	.113	"	.113
	Pipe Lengths 4' to 7'			
1.	Pick up pipe from tank and move back into position.	.083	"	.083
2.	Run pipe over revolving brush.	.102	"	.102
3.	Wash outside of pipe with sponge.	.456	"	.456
4.	Pull pipe off brush and place on pipe rack.	.136	"	.136
	Pipe Lengths 7' to 10'			
1.	Pick up pipe from tank and move back into position.	.103	"	.103
2.	Run pipe over revolving brush.	.124	"	.124
3.	Wash outside of pipe with sponge.	.553	"	.553
4.	Pull pipe off brush and place on pipe rack.	.172	"	.172
1.	Carry sections of pipe to wash tank - 42 trips - total ft. walked 3000.	31.450	"	31.450
2.	Carry sections of pipe to assembly position - 36 trips - total ft. walked 2500.	27.310	"	27.310
3.	Walk 830 ft. around pipe to tighten and loosen hex nuts.	8.930	"	8.930
4.	Walk 20 ft. turn on hose, return with hose to pipe rack.	.457	"	.457
5.	Rinse pipe.	4.160	"	4.160
6.	Walk 20 ft. return hose, turn off water, return to pipe rack.	.463	"	.463

Performance Rating	80%
Allowances	20%
Total	100%