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A PROPOSAL TO EQUIP METAL SILOS IN JORDAN WITH AERATION AND TEMPERATURE MONITORING EQUIPMENT

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A PROPOSAL TO EQUIP METAL SILOS AT RUSEIFA AND IRBID GOVERNMENT OF JORDAN STORAGE SITES WITH AERATION AND TEMPERATURE MONITORING EQUIPMENT

During my recent visit to Jordan, I observed 25 metal silos at Ruseifa and 10 metal silos at Irbid which were not in use because of previous grain losses in the silos.

In the past, grain stored in metal silos in Jordan has been lost as a result of deterioration. Although all circumstances are not known, it appears that grain lost by deterioration in the silos was either wet when placed in the silos or became wet during storage. If moisture content of the grain had been known prior to storage and if grain was properly managed during storage, most of the loss could have been prevented.

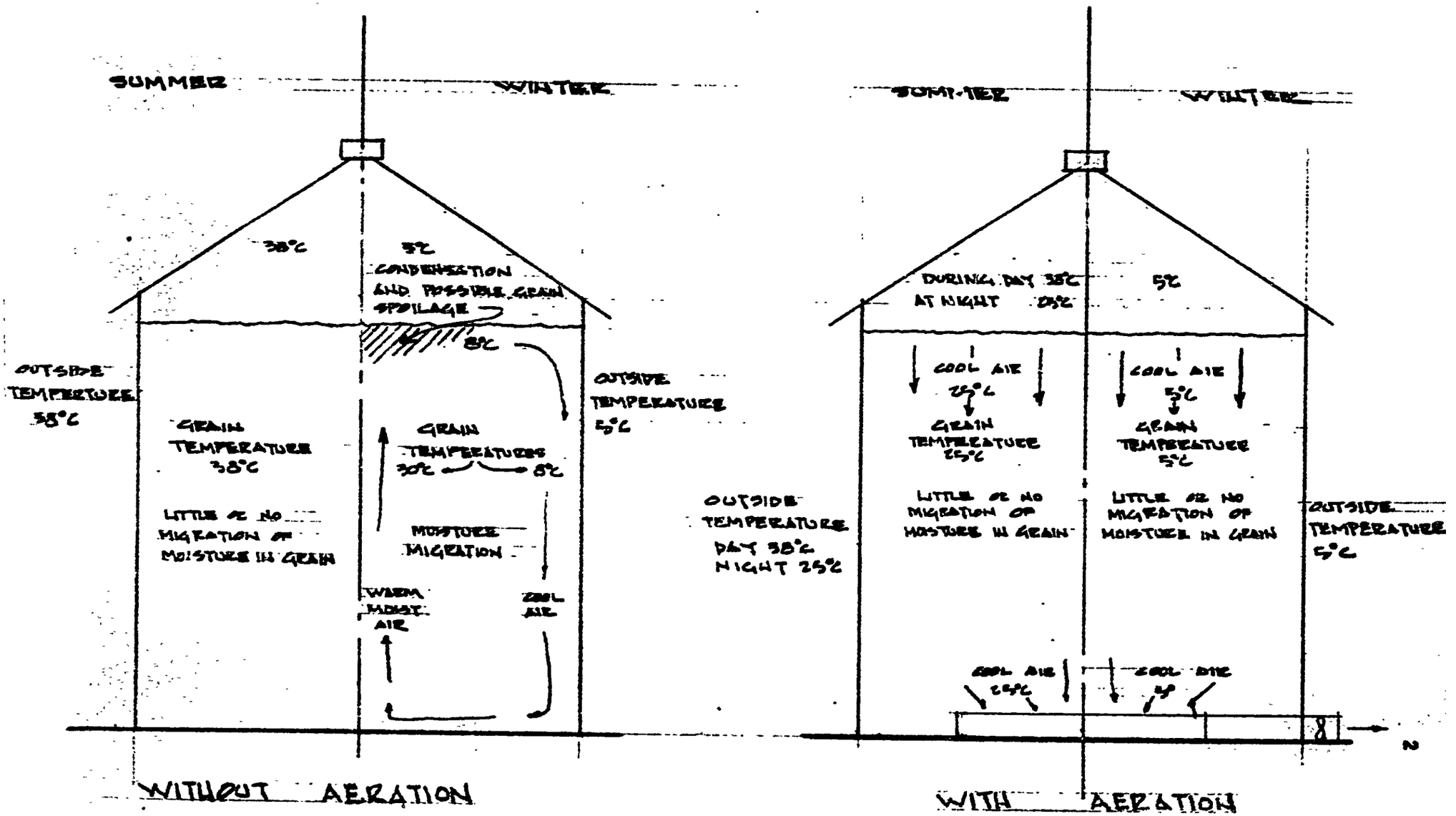
Moisture content of stored grain is one of the most important factors affecting safe storage of grain. Grain, for extended periods of storage, should be 12.0% moisture content or lower. Slightly higher moisture content grain can be stored safely, however, it then becomes more important to be able to "turn" the grain to cool it and equalize temperatures and to redistribute moisture in the grain mass. If physical "turning" of the grain (moving grain from one bin to another) is not practical, the same cooling and equalization of temperatures within the grain mass can be accomplished by aeration (movement of air through the grain mass in the bin or silo).

Temperature differences between grain in silos and air surrounding the silos can result in moisture translocation and accumulation at the surface of the grain mass (see Figure 1). Grain at time of harvest or when it is placed in storage, generally is warm--90 to 100°F (32 to 38°C). As outside temperatures get colder, grain near the silo walls and at the surface cools first; but since grain loses heat slowly, grain in the center of the silo remains warm. Differences of temperatures within the grain mass result in air movement within the grain mass. Cool air moves down the outer walls of the silo forcing warm moist air up through the center of the silo. As the warm moist air reaches the surface grain, it is cooled rapidly and condensation occurs. Even though moisture content of the grain may have been 12.0% when placed in storage, accumulations of moisture at the grain surface, due to air currents, can result in grain deterioration.

As indicated previously, grain can be cooled and temperatures equalized by "turning" the grain or by aeration (moving air through the grain).

In my opinion, the 25 silos (at Ruseifa and Irbid), together with up to 50 additional silos which have not been assembled, can be modified and equipped to provide safe storage for bulk grain. The following paragraphs outline a plan to demonstrate that the silos can be successfully used. If the test outlined in the following paragraphs is successful, the next step would be to modify and equip all metal silos now standing at Ruseifa and Irbid and to erect the unassembled silos with the proper modifications.

FIGURE 1. MOISTURE MIGRATION AND ACCUMULATION



Three Silo Test to Demonstrate Safe Storage of Grain in Metal Silos at Ruseifa, Jordan

The following is an outline of a proposal to demonstrate safe storage of grain in metal silos in Jordan.

This test should be conducted at the Government of Jordan storage site at Ruseifa. Three metal silos should be selected adjacent to one another and should be modified and equipped as follows:

Silo Modification

1. The base of each of the three silos (at the point where the metal wall and concrete foundation intersect) must be thoroughly sealed on the inside of the silo and on the outside of the silo. This seal may be made with asphalt or other sealant which will remain flexible and make the wall-foundation juncture watertight (Figure 2A).

2. Sections of the silo walls must be sealed from the inside of the silo at the point where sections are bolted together to make the joints waterproof (Figure 2B).

3. Silo roofs must be securely fastened in place using brackets provided and bolts with lock washers (Figure 2C). Additional brackets should be provided on the prevailing windward side. Roofs must be secured as close to the silo wall as possible to reduce the possibility of rain blowing in under the roof.

4. Roof caps must be sealed in place using asphalt or other sealant to make the joint between the cap and roof raintight (Figure 2D).

Filling hatches (there are two on each silo roof) must be sealed in place to prevent rain from entering. A waterproof tape should be used for sealing the hatches since it will be necessary to open the hatches to aerate the grain periodically.

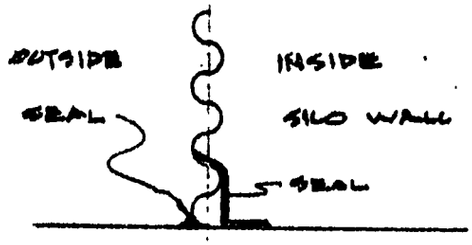
Weather tight ventilators should be installed at the very peak of the roofs to provide ventilation for the silo. The ventilator must be sealed to the roof to make the installation rainproof (Figure 2D). Ventilators like those on the concrete bins at Ruseifa may be used.

Aeration System

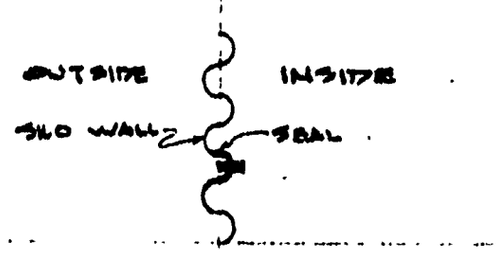
1. Aeration systems must be placed in two of the three silos.

2. Specifications and diagrams for aeration ducts, fans and layout are shown in the attached sheets. Briefly the aeration system will require an aeration duct with 20 square feet (1.86 M^2) of screen surface with a cross section area of 0.5 square feet (.047 M^2). The fan may be either of the

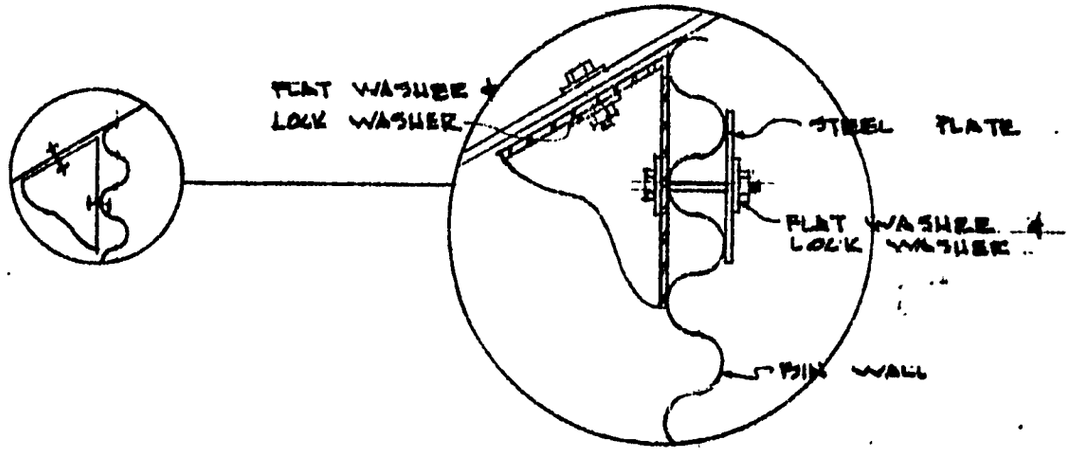
FIGURE 2. SILO MODIFICATIONS



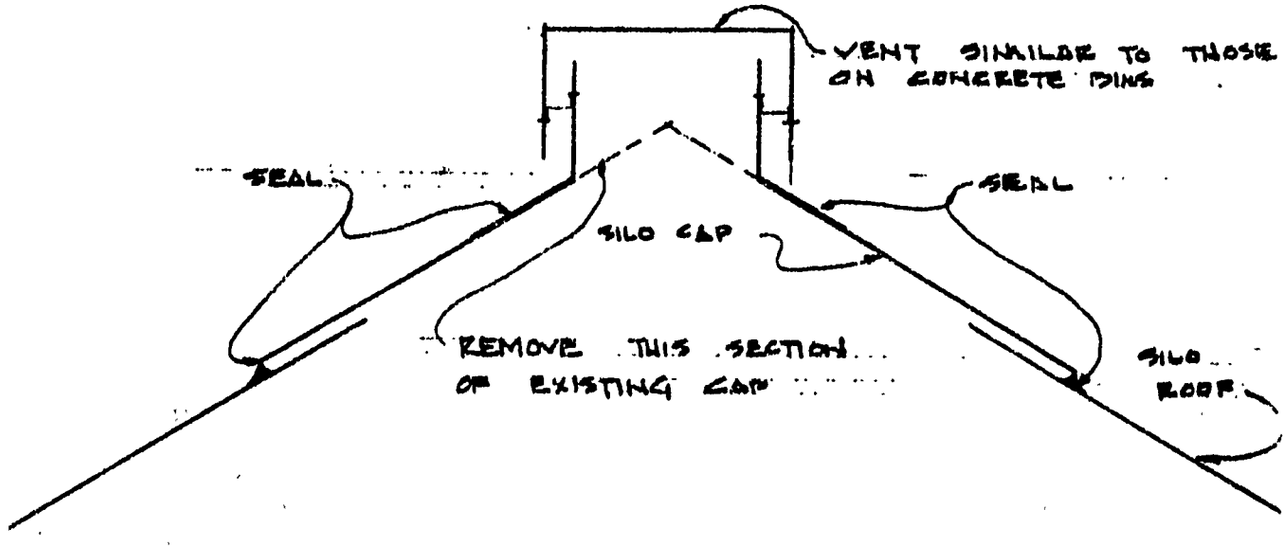
A. SEAL SILO WALL AT JOINT WITH CONCRETE SLAB



B. SEAL INSIDE OF SILO AT JOINT BETWEEN



C. ROOF BRACKETS TO SECURE ROOF



D. INSTALL VENT AND SEAL ROOF CAP TO MAKE IT WATERPROOF

propeller or centrifugal type but must move 400 cubic feet (11.2 M^3) of air per minute against a static pressure of 1.5 inches of water (38.1 MM).

3. The aeration system shown in the attached diagrams can be locally fabricated and installed. Care must be taken to assure a rain-tight seal between the duct, fan and silo wall. A tight seal is also necessary to assure against air losses.

4. The fan must be installed to exhaust air from the grain. When the aeration system is operated, one or both of the roof hatches must be open. An opening of at least two times the cross sectional area of the aeration duct must be provided.

5. Fans can be purchased and aeration ducts made locally in Jordan.

Temperature Monitoring Equipment

1. Thermocouple cables must be installed in the three silos as shown in the attached specifications.

2. A potentiometer is used to read temperatures at the various thermocouple levels.

3. Temperatures must be read and recorded at least once each week. Temperatures should be read and recorded daily when grain is being aerated.

Temperature and Relative Humidity Equipment

1. A hygro-thermograph and sling psychrometer should be obtained for use at the storage site. This equipment may be available locally. See attached specifications.

2. The hygro-thermograph must be positioned so that it measures and records the atmospheric temperature and relative humidity but is protected from rain, etc. A weather station type housing provides this type situation.

3. The hygro-thermograph will provide a continuous record of temperature and relative humidity. These records must be saved. They provide information that is necessary to properly operate the aeration systems in the silos.

4. A sling psychrometer measures dry bulb and wet bulb temperatures providing a means of checking and adjusting the hygro-thermograph. The hygro-thermograph must be checked and adjusted weekly.

Moisture Tester Equipment

1. A moisture tester is necessary to determine moisture content of grain. The moisture content of grain will determine whether the grain can be safely stored or whether action must be taken to dry or dispose of the grain. See attached specifications.

2. A moisture tester is also necessary to check grain samples taken from silos periodically.

Grain Sampling Equipment

1. A deep bin trier (probe) should be obtained to be used in sampling grain stored in the silos (see attached specifications). This trier can also be used for sampling grain stored in concrete bins. A grain trier may be available at the Ruseifa storage site which could be modified to take deep samples.

2. Official grain dockage sieves. See attached specifications. These sieves should be used in checking grain samples taken from silos before wheat is placed in silos and when received at port or storage sites. Sieves will separate weevils and foreign material from wheat and corn. These sieves, I believe, are available at the Ruseifa storage site.

OUTLINE OF STORAGE TEST

1. Determine moisture content of wheat to be stored in the 3 silos.
   a. If grain is above 13.5 per cent moisture content, it should not be placed in storage for this test.
   b. Grain with moisture content above 13.5 per cent should be considered unsafe for long term storage without drying or other special handling.

2. Place approximately 100 metric tons of grain in each of the 3 silos previously selected.
   a. All 3 silos should have been modified structurally and equipped with temperature monitoring cables as indicated.
   b. 2 of the silos, in addition to modification, should be equipped with aeration systems as described.

3. Fumigate grain with Phostoxin as it is placed in the silos.
   a. Fumigation can be accomplished by having an individual throw Phostoxin tablets into the silo from the top filling hatches as the silo is filled with grain.
   b. 3 tablets per metric ton should be placed in the grain equally distributed throughout the grain mass.
   c. Following fumigation, the silo should be closed by covering the filling hatches and the top ventilator. Do not enter or open the silo for 5 days.

4. Initial sampling and temperature recording.
   a. After 5 days open the top filling hatches and operate the aeration fan for about 15 minutes. Allow the silo, without aeration, to remain open approximately 2 hours prior to taking samples.
   b. Stop the fan and take samples as indicated in "Sampling Procedures." Determine moisture content, presence of insects and condition of grain.
   c. Record temperatures in each silo using the temperature monitoring system.

5. Operate the aeration systems in the two silos as indicated in "Operation of Aeration Equipment."
   a. Timers should be set to automatically operate fans from 8:00 P.M. (2000 hours) to 4:00 A.M. (0400 hours) daily until the grain has been completely cooled by aeration.
   b. If rain, drizzle, mist or fog are expected on a given night, fans should not be operated.

6. Subsequent sampling and temperature recording.
   a. During the aeration period, temperatures should be recorded daily.
   b. After aeration has been completed, temperatures should be recorded weekly.
   c. Samples of grain should be taken monthly after the initial sampling and the same information recorded.

7. Grain condition.
   a. If grain becomes infested or otherwise goes out of condition, it should be disposed of by the best means possible.
   b. Infestation may be controlled by proper fumigation with Phostoxin. Specific instructions will be supplied on request.
   c. Minor grain heating problems can sometimes be controlled by aeration.

8. Atmospheric temperature and relative humidity should be recorded using a hygro-thermograph.
   a. Data gathered with this equipment will be needed to properly evaluate the test results.
   b. With successful completion of the test, this data will also be needed for future grain aeration scheduling.
   c. The hygro-thermograph should be checked and adjusted weekly.

9. Termination of storage test.
   a. The test can be terminated after demonstrating the potential for safe bulk storage in metal silos.
   b. The test may be continued to demonstrate more than one seasons' safe storage if desired.

OPERATION OF AERATION EQUIPMENT

Maintaining the quality and condition of stored grain by aeration involves the movement of atmospheric air of acceptable temperature and humidity through the grain.

The condition and moisture content of grain to be aerated are very important and can determine the success or failure of aerating. Aeration cannot be expected to greatly improve grain already in poor condition.

Aeration involves the moving of air through stored grain at low air flow rates (usually between 1/20 and 1/10 cubic feet per minute (CFM) per bushel), for purposes other than drying to maintain the quality of stored grain.

Aeration can be used for the following related purposes:

1. Cooling stored grain.
2. Equalizing temperatures in stored grain.
3. Removing odors from stored grain.
4. Applying fumigants to stored grain.
5. Holding moist grain for short periods of time.

Cooling Stored Grain

Cooling stored grain by drawing cool air through the grain mass helps to reduce mold and insect development. Most grains when cooled to below 70°F (21°C) and stored at or below moistures of 13.0 to 13.5% will generally not support mold growth. If molds do grow they grow very slowly. Similarly insect activity and reproduction is greatly decreased at temperatures below 60°F (15°C). At 40°F (5°C) most grain infecting insects become dormant and may die of starvation. Cooling of grain to about 50°F (10°C) will assure relatively safe storage of grain of proper moisture content.

Equalizing Temperatures in Stored Grain

As was pointed out earlier, differences in temperatures between the atmospheric air and grain mass can result in air movement within the grain. These air movements will cause moisture migration and condensation at the grain surface which may cause the grain to spoil. Equal temperatures throughout the grain reduces the possibility of condensation with resultant spoilage. Indirectly maintaining uniform temperatures and uniform moistures in the grain mass reduces the potential for insect and mold development.

The other three uses will not be discussed here.

Cooling Zones

When cool air is moved through a warm mass of grain, a cooling zone is formed. This zone forms first in the grain nearest the point where the air enters the grain. As aeration progresses, the zone moves through the grain in the direction the air is moving. Behind the zone the grain approaches the temperature of the entering air. In front of the cooling zone the grain remains at the initial temperature of the grain.

Cooling as a Result of Evaporation

When air is moved through grain, there is an exchange of both heat and moisture. Usually the grain assumes the temperature of the air. If the relative humidity of the air is higher than the equilibrium moisture content of the grain, moisture from the air transfers slowly to the grain. If the moisture content of the grain is above that in equilibrium with the air, moisture is transferred from the grain to the air and some drying of the grain takes place. For conditions present in Jordan the rate of drying would exceed the rate of rewetting. Moisture content of the grain is not reduced greatly by the drying resulting from aeration, but cooling resulting from evaporation may account for 50% of the heat removed from the grain. Even though cool air used for aeration may have a high relative humidity, it is able to evaporate moisture from the grain when it reaches the grain temperature. This effect is greatest at high grain temperatures and results from aeration air being warmed and thus being capable of holding more moisture.

Control of Aeration Fans

Either manual or automatic controls can be used to operate aeration fans. Manual control is most effective when a person is on duty overnight and on weekends to turn fans on when atmospheric conditions are suitable for aeration.

Automatic controls provide the greatest cooling over a given period of time. Various systems of automatic control can be used successfully. 1. Time clocks can be used to operate fans a predetermined number of hours at pre-selected times of the day. 2. A differential thermostat can be used to operate fans when a predetermined differential between high limit and low limit sensing bulbs is exceeded. With downward air movement in the silo, the high limit bulb should be placed 3 feet above the silo floor and 3 feet from the silo wall. The low limit bulb should be placed in a shady location in outdoor air. A 15°F differential between bulbs will cool grain about 10°F.

For this test an automatic timer set to operate aeration fans from 8 P.M. (2000 hours) to 4 A.M. (0400 hours) the following morning should be used. Fans should be operated if the expected temperature for a given night is the same or lower than the warmest grain temperature in the silos. Grain temperatures should be determined by reading the temperature monitoring system in each silo.

Operating Schedules

Generally grain should be cooled by aerating it by successive stages, each cooling stage beginning when substantial cooling becomes possible with seasonal change. Reduction of grain temperature soon after grain is stored helps to retard insect activity and mold development.

Although exact temperatures for the Ruseifa storage site are not known, a tentative schedule for fan operation is as follows:

PERIOD	OPERATE FANS WHEN AIR TEMPERATURE IS	EXPECTED RANGE IN GRAIN TEMP.	APPROXIMATE FAN OPERATING TIME
June - Sept. 15	Below 80°F (27°C)	75 - 85°F	80 hours
Sept. 15 - Nov. 15	Below 65°F (18°C)	60 - 70°F	120 hours
Nov. 15 - Feb.	Below 50°F (10°C)	45 - 55°F	160 hours
Mar. - June	Below 70°F (21°C)	70°F	120 hours

Since average monthly temperatures do not vary greatly, aeration one time after placing grain in storage should reduce the grain temperature to approximately 70°F. A subsequent aeration during October should re-establish equilibrium temperatures within the grain mass and lower the temperature slightly to approximately 60 - 65°F. Aeration should not be required during the winter months (November through February) when heavy rainfall occurs. If grain temperatures indicate the need for aeration, it should be accomplished during non-rainfa periods. Once aeration of a grain mass is started, it should be continued without long interruption until the cooling zone has moved completely through the grain. In spring (March or April) following the heavy rain season, the grain should agai be aerated to equalize the temperatures without appreciably increasing the temper ture.

Aeration should be continued until uniform temperatures are present throughout the grain mass. When uniform grain temperature is shown by the temper ture monitoring system in each silo, the amount of fan operating time since start of the aeration period should be determined and the fans operated an additional equal period of time. For example, if it takes 40 hours of fan operation to show equal temperatures on the monitoring system, fans should be operated an additiona 40 hours. This additional time is required to assure aeration of the grain at the bottom outside edges of the silo. The central location of the temperature monitoring cable will give equal temperature readings before the entire grain mas has come to equilibrium.

SAMPLING PROCEDURES

During the test period, it will be necessary to take grain samples from each of the three silos to determine condition of the grain.

Samples should be taken prior to starting aeration and at monthly intervals thereafter.

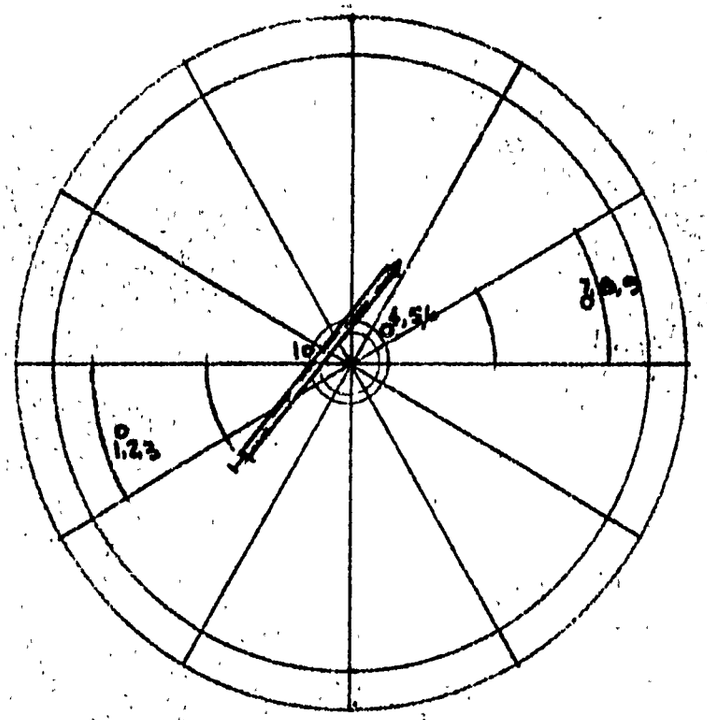
The deep bin trier described in the attached specifications should be used to take the samples. A total of 10 samples should be taken from each silo at each sampling time. Three samples at 5 feet vertical intervals should be taken vertically at each of the two silo roof openings. Three samples at 5 feet vertical intervals should be taken vertically in the center of the silo. One sample should be taken horizontally just beneath the surface of the grain in the center of the silo. (See the attached diagram.)

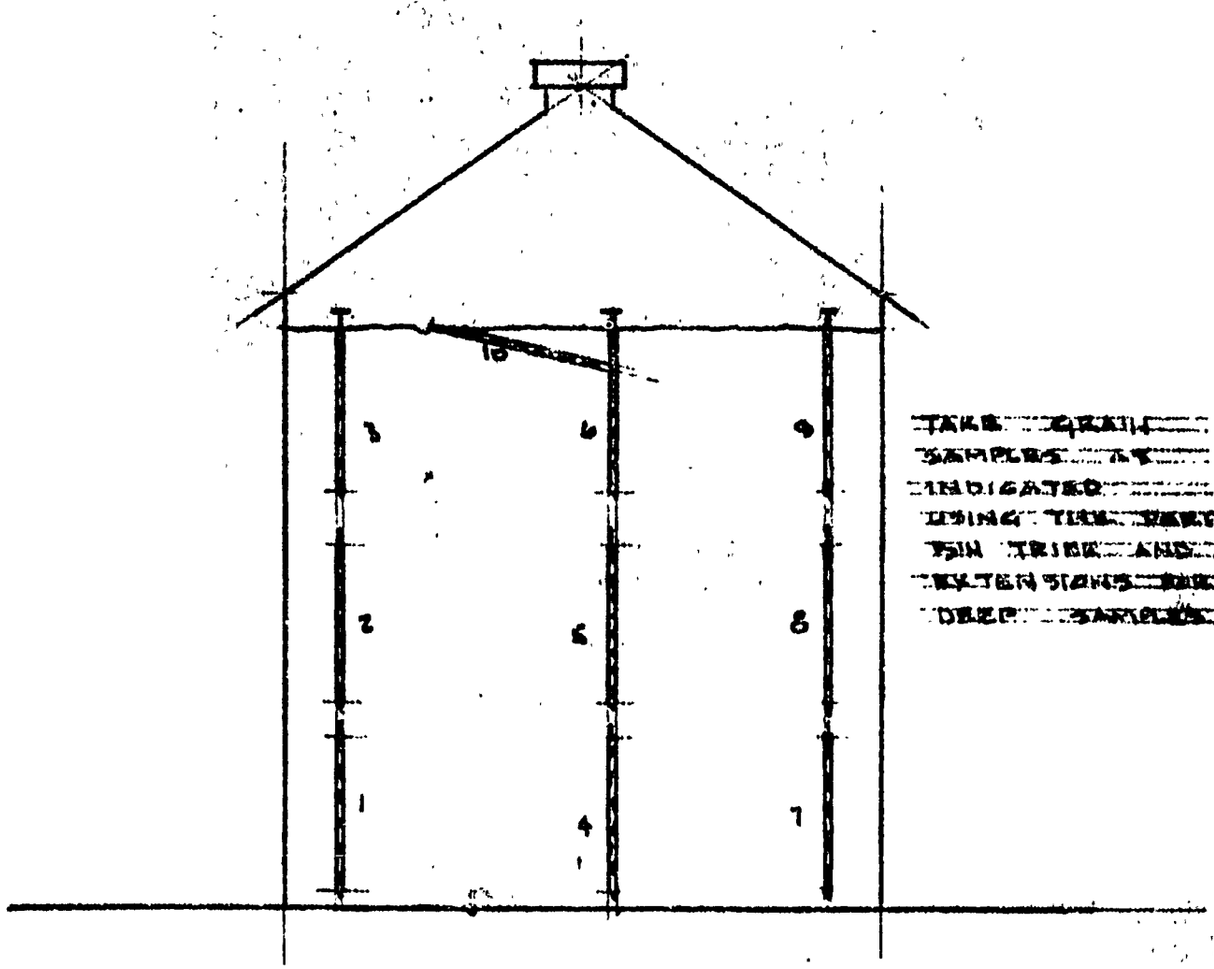
The temperature of each sample should be recorded and the percent moisture content determined and recorded.

Each sample should be sifted using the grain dockage sieves and numbers and type of insects recorded.

SAMPLING POINTS FOR SILOS

DIAGRAM 5





TAKE GRAIN SAMPLES AT INDICATED USING THE SHORT PIN TRIER AND EXTENSIONS FOR DEEP SAMPLES.

SPECIFICATIONS FOR AN AERATION SYSTEM FOR 100 M.T. CAPACITY ALUMINUM SILOS

GOJ Ruseifa and Irbid Storage Sites

Silo Dimensions

Diameter 18 feet = 5.5 meters
Height (at side wall) approx. 18 feet = 5.5 meters
Height (to roof peak) approx. 24 feet = 7.2 meters
Floor area - 255 square feet = 23.7 square meters
Storage volume - 4590 cubic feet = 128.5 cubic meters

Silo Capacity

Storage capacity (wheat) - 3670 bushels = 100 M.T.
Storage capacity (corn) - 3690 bushels = 94 M.T.

Type of System and Air Flow

Single duct - Fixed fan system (See attached diagram 1)
Air flow rate (cubic feet per minute per bushel) = 0.10 CFM/BU. = 0.10 CMM/M.T. (cubic meters per minute per metric ton)

Duct Layout

See attached diagram 1. Two alternatives are shown for duct designs in diagrams 3A and 3B.

Air Volume Required (for each silo)

Silo capacity = 3670 bushels = 100 M.T.
Air flow rate = 0.10 CFM/BU. = 0.10 CMM/M.T.
Air volume 367 ft^3/MIN. = 10 M^3/MIN.

Fan* and Motor** Requirements

Air volume - 367 ft^3/MIN. = 10 M^3/MIN.
Static pressure - 1.45" SP. of water = 36.8 MM. SP. of water
Estimated power requirement - 0.05 HP/1000 BU. x 3.67 = 0.18 HP.
Motor selection - Use 1/3 HP. motor

*NOTE: Either axial flow (propeller type) or radial flow (centrifugal type) fans can be used at less than 4" SP. Axial flow (propeller type) fans are preferred at low static pressures. If a radial flow fan is used, it should be a "backward-curve" centrifugal fan. (See attached diagram 2).

**The air volume required (367 ft^3/M) at a static pressure of 1.45" of water provides a power requirement of 0.18 horsepower. So that the system is not under-powered, a 1/3 HP. motor is recommended.

Duct Requirement

Shape and type - Square or triangular. See attached diagrams 3A and 3B.

Maximum allowable

Air velocities	Wheat	1,500 feet/min. (FPM)
	Corn	1,000 feet/min. (FPM)

Cross section area

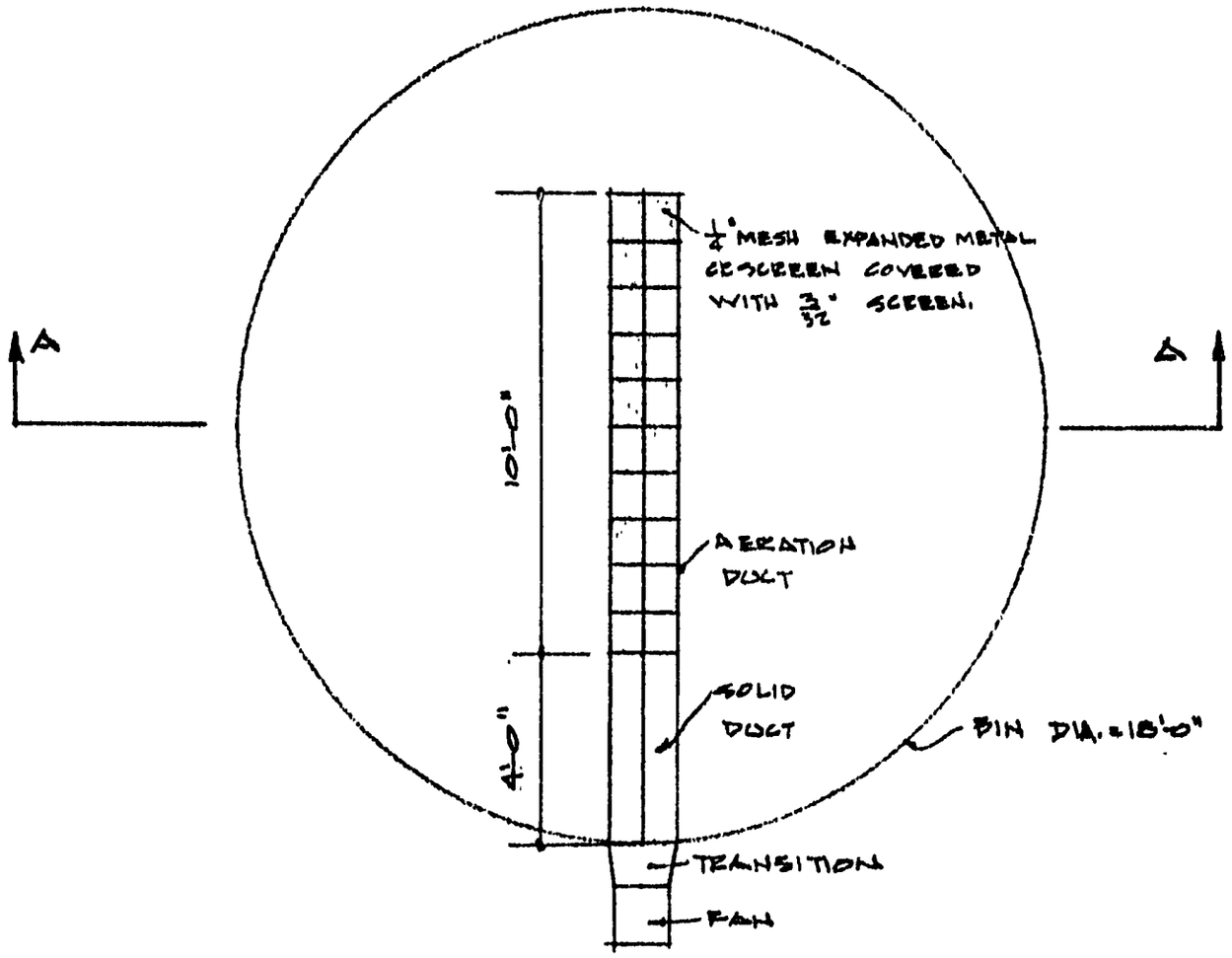
Wheat $\frac{\text{Air volume } (ft^3/\text{MIN.})}{\text{Air velocity(FPM)}} = \frac{367}{1500} = 0.245\ ft^2$

Corn $\frac{\text{Air volume } (ft^3/\text{MIN.})}{\text{Air velocity(ft/MIN.)}} = \frac{367}{1000} = 0.367\ ft^2$

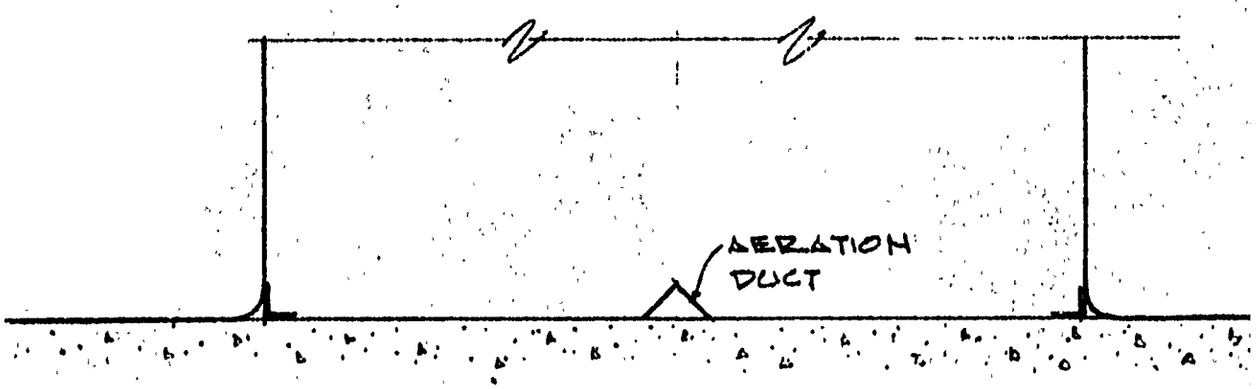
Duct should have cross section area of 0.5 ft^2.

AERATION SYSTEM FOR METAL SILOS - G.O.J. RUSEIFA OR IRBID STORAGE SITES

DIAGRAM 1



PLAN

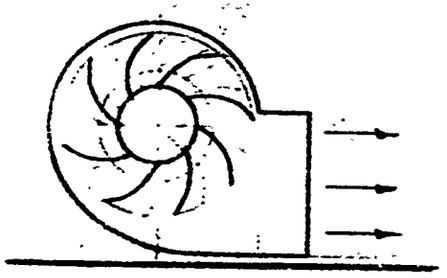


SECTION A-A

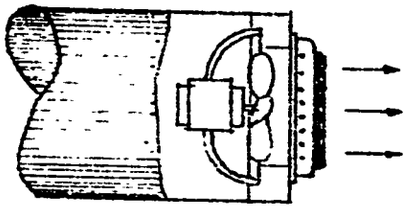
SCALE 1/4"=1'-0"

AERATION FANS

DIAGRAM 2



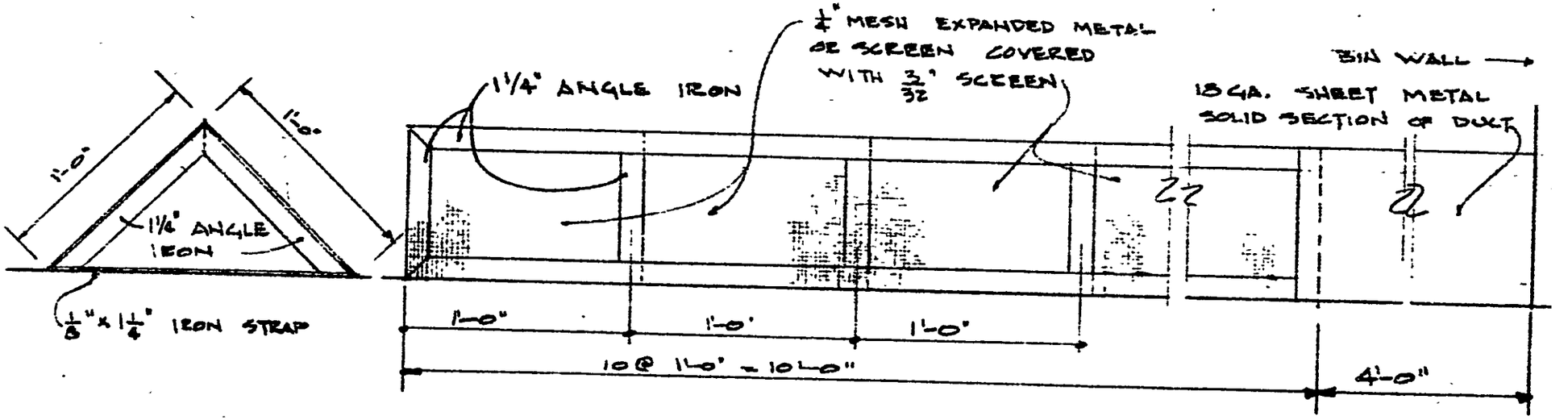
RADIAL FLOW
(CENTRIFUGAL) FAN
EQUIPPED WITH
BACKWARD CURVE TIP BLADE



AXIAL FLOW
(PROPELLER) TYPE FAN

DETAIL: TRIANGULAR AERATION DUCT

DIAGRAM 3A



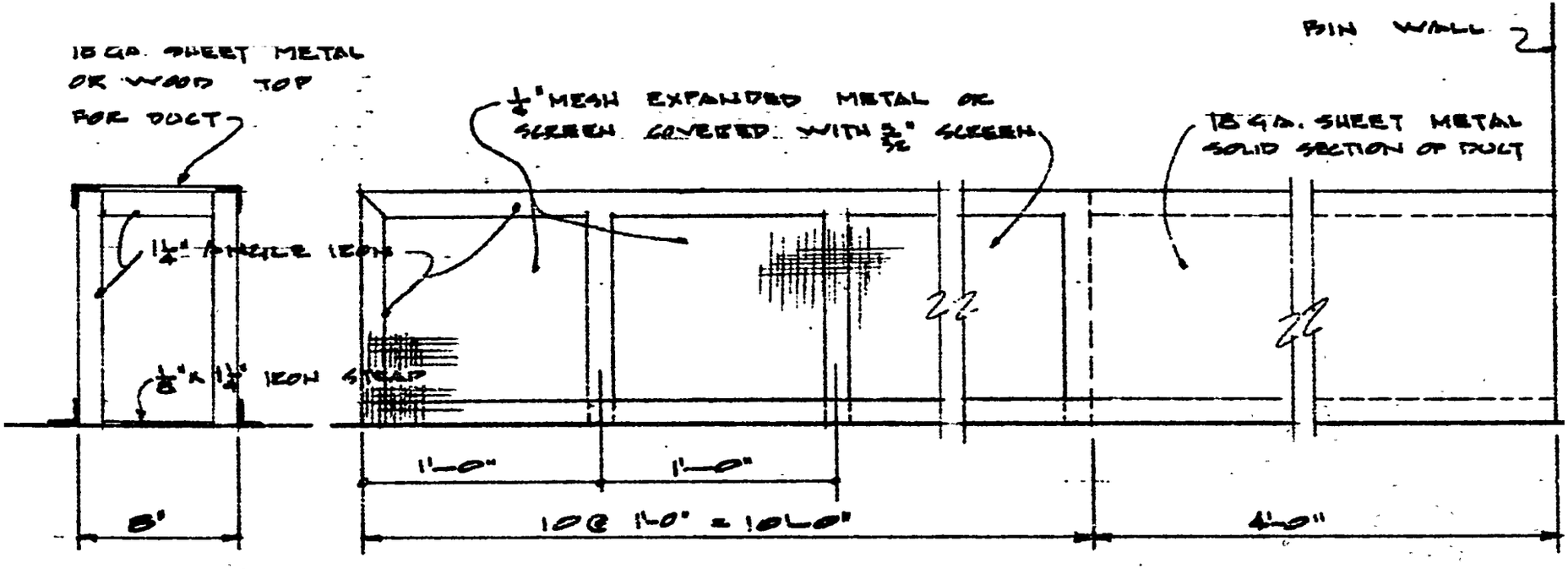
END VIEW

SIDE VIEW

SCALE 1½" = 1'-0"

DETAIL: RECTANGULAR AERATION DUCT

DIAGRAM 3B



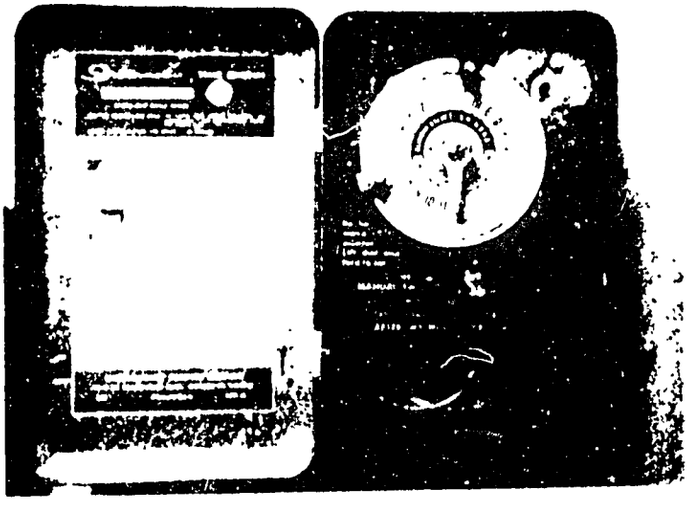
SCALE: 1½" = 1'-0"

SPECIFICATIONS--AUTOMATIC TIMER

A timer should be used to automatically turn aeration fans on and off at predetermined intervals. An alternative method would be to have an individual manually turn the fans on and off as required.

Timers such as the one pictured below may be available locally in Jordan. If not, they may be ordered from:

International Register Company
2624 W. Washington Boulevard
Chicago, Illinois



To order, indicate the following:

2 Intermatic Time Switches
Similar to Model 103
Double pole, single throw
Specify switch rating per pole 40 amps; 4375 watts tungsten (incandescent); 1 HP; 690 VA pilot duty; 220 volts AC.
Clock motor rating: 220 volts, 50 cycle.

SPECIFICATIONS FOR TEMPERATURE MONITORING SYSTEMS

Each silo must be equipped with a temperature monitoring system which should be designed as follows (See diagram 4):

1. A series of 6 thermocouples should be spaced at about 5 feet intervals along a cable to be suspended from the center of the bin roof vertically to the bottom center of the silo.

2. The thermocouple cable must be covered by a vinyl or nylon coating to protect the thermocouples from abrasion and/or corrosion by fumigants.

3. The thermocouple must be suspended by a bracket from the peak of the silo roof vertically to the bottom of the silo.

4. Thermocouple lead wires should be extended down the exterior of the silo walls to a weather-proof reading outlet.

One portable potentiometer will be required to take periodic temperature readings from each of the 3 silos.

Systems meeting the above specifications are available approximately two weeks after receipt of order from:

Burrows Equipment Company
1316 Sherman Avenue
Evanston, Illinois 60204

To order, indicate the following:

3 Rolfes Portable Grain Temperature Scanning Systems

Bin (silo) size	18' dia. x 24' height
No. cables/bin	1
Thermocouples/cable	6 at 5' intervals
Price/cable (vinyl)	$25.95
Hanger assembly	Universal (for British made Fredrick Brady and Co., Ltd. silos)

1 Rolfes Portable Potentiometer (metal encased, battery operated, portable with jack handle)
PRICE: $310.00

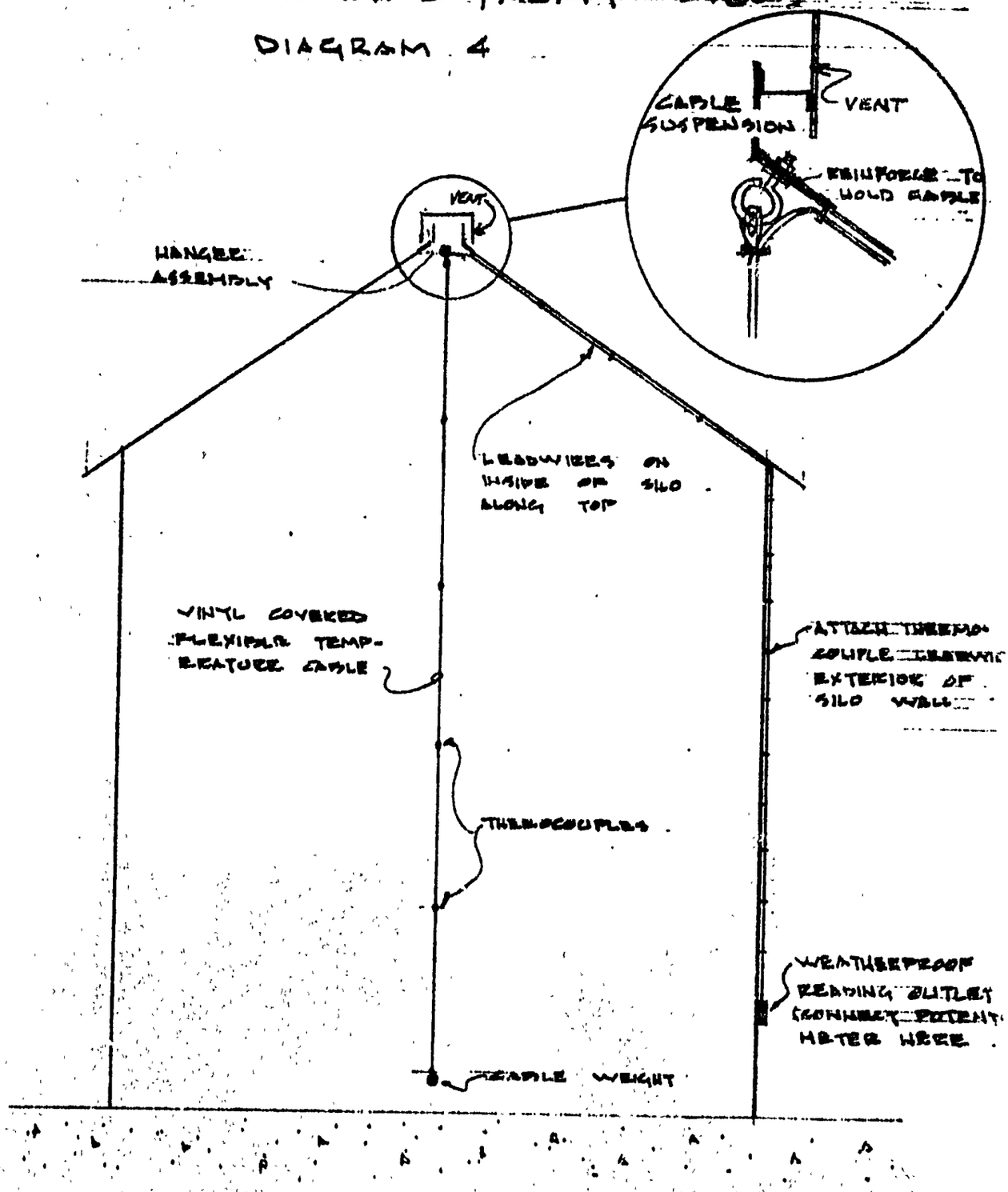
<u>COST</u>:

3 Rolfes Portable Grain Temperature Scanning Systems at $25.95 each -	$ 77.85
1 Rolfes Portable Potentiometer	310.00
Spare batteries	
TOTAL COST	

Above prices are F.O.B. Evanston, Illinois.

TEMPERATURE MONITORING SYSTEM FOR 100 M.T. CAPACITY SILOS

DIAGRAM 4



SECTION

NO SCALE

SPECIFICATIONS FOR TEMPERATURE AND RELATIVE HUMIDITY RECORDING AT STORAGE SITES

Temperature and relative humidity for a specific storage site must be known on an hourly basis to be able to operate grain aeration systems properly.

Two pieces of equipment necessary to determine and record atmospheric temperature and relative humidity are (1) A hygro-thermograph--a device for measuring and recording temperature and relative humidity, and (2) A sling psychrometer--a device for measuring wet bulb and dry bulb temperatures. Relative humidity is calculated from wet and dry bulb temperatures. This information must be used to adjust the hygro-thermograph weekly.

The hygro-thermograph should be capable of the following:

1. Recording temperature and relative humidity on a chart for a period of one week.

2. Measuring and recording temperatures in the range 10 - 110°F (-12°C to 43°C).

3. Measuring and recording relative humidity in the range 0 - 100%.

The sling psychrometer should have thermometers with a range of 10 - 100°F (-12°C to 43°C). It should have two thermometers (one dry bulb and one wet bulb thermometer).

Both the hygro-thermograph and sling psychrometer may be available locally in Jordan. Consult the Ministry of Communications, Meterological Department for possible loan or local source of this equipment.

If the hygro-thermograph and sling psychrometer are not available in Jordan, they can be purchased from:

Burrows Equipment Co.
1316 Sherman Avenue
Evanston, Illinois 60204

To order, indicate the following:

1 Bendix Hygro-Thermograph, No. 594 Weekly Recording with following accessories: Instruction booklet, 100 weekly charts and special recording ink #504974-4

PRICE $235.00

1 Sling Psychrometer No. 219, Weksler Pocket Type with field case PRICE $ 13.75

1 Slide Rule No. 219R for converting wet bulb - dry bulb temperatures to relative humidity

PRICE $ 3.10

Above prices are F.O.B. Evanston, Illinois.

SPECIFICATIONS FOR MOISTURE TESTING EQUIPMENT

Moisture content of stored grain is one of the most important factors affecting safe storage of grain.

For the present test we are proposing, and for future use at Ruseifa, Irbid and Aqaba, the moisture tester required should:

1. Be easily and simply operated
2. Reliable
3. Portable
4. Durable

There are many moisture testing units, all of which are precision machines. They required frequent, periodic cross checking with the air-oven moisture determination method. The moisture tester which seems the most adaptable for use in Jordan is the Universal Moisture Tester (see the attached description sheet). This moisture tester is available from:

Burrows Equipment Co.
1316 Sherman Avenue
Evanston, Illinois 60204

To order, indicate the following:

1 Universal Moisture Tester, Model EH, complete with all accessories. Range 8½ to 40% moisture content. $495.00

Price is F.O.B. Evanston, Illinois.

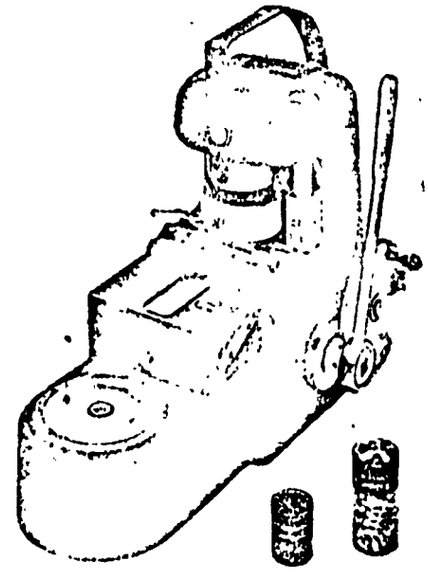
Burrows EQUIPMENT CO. / 1316 SHERMAN AVE. / EVANSTON, ILL. 60204 / UNIVERSITY 4-4175

BURROWS Universal Moisture Tester

A HIGH PRESSURE SYSTEM THAT GIVES YOU

- **Direct moisture percentage readings on a dial . . instantly**
- **Automatic and immediate temperature reading**
- **An instrument that can't get out of calibration or adjustment**
- **An instrument that requires no maintenance**
- **OPERATES ELECTRICALLY**

. . . YET REQUIRES NO ELECTRICAL OUTLETS



Designed and constructed upon a highly-perfected principle entirely different from that of other testers. Gives you consistently accurate and satisfactory moisture testing. The operation is based on the importance—to you—of knowing the exact moisture content of your grain, seeds, fertilizers, meal and other commodities. Your business profits depend on the accuracy of your moisture tests. Overall dimensions: 12" high, 9" wide, and 19" deep. Portable. This compact instrument can be used for field testing—a practical feature saving you time and money over the years.

NOTE: Model EH can be used for testing oil-bearing grain or seed down to approximately 5 or 6% by using a factor.

HOW IT WORKS: The sample cup is removed from the instrument and filled. Next the sample is compressed to a pre-determined thickness setting as registered on a micrometer gauge. Different settings are used for various products. A built-in thermometer gives the temperature reading. The operator turns the crank on the ohmmeter-generator and obtains a reading. The final step is to rotate the upper plate of the correlator dial at the front of the instrument aligning the meter and temperature reading and the actual moisture percentage of the sample is read directly on the outer scale of the dial. To remove the sample, compression is released and sample cup is withdrawn from housing to be emptied.

A FEW SATISFIED USERS—

General Foods
Glidden Company
Ohio Farm Bureau Cooperative Assn., Inc.
Pillsbury Mills, Inc.
Quaker Oats Company
Ralston Purina Company
Archer-Daniels-Midland Company
Cargill, Inc.
Central Soya Co. Inc.
Colorado Milling & Elevator Co.
Continental Grain Company
Crookham Company
Albert Dickinson Company
The Early & Daniel Co. Inc.

Howard Myers, operating five elevators in Ohio and Indiana, says:

"The UNIVERSAL is simple and accurate. We've had more farmer satisfaction with the UNIVERSAL . . . never more than 1/10th of 1% difference when checking. Its consistent accuracy is something no other instrument offers."

PRICES

Model EH Complete with all accessories. Range 8½-40% $495.00
Model A Complete with all accessories. Range 10-25% 445.00

SPECIFICATIONS--OFFICIAL GRAIN DOCKAGE SIEVES

Grain dockage sieves are made of aluminum and measure 12-7/8" in diameter and 2-3/8" deep.

Sieves may be ordered from:

Burrows Equipment Co.
1316 Sherman Avenue
Evanston, Illinois 60204

Order:

1 No. 610A Corn Sieve, Round Perforations, 12/64 inch	$5.75
1 No. 610C Weevil Sieve, Round Perforations, 1/12 inch	5.75
1 No. 610E Solid Bottom Pan	3.50

Above prices are F.O.B. Evanston, Illinois.

SPECIFICATIONS--DEEP BIN TRIER

[redacted]

Overall length of trier is 63", 1-3/8" outside diameter, 11 openings. Samples can be taken from any depth by adding 3' extensions and T-handle.

Can be ordered from:

Burrows Equipment Co.
1316 Sherman Avenue
Evanston, Illinois 60204

Order:

1 No. 570 Deep Bin Trier		$52.00
3 No. 571 3' Extensions	($2.50 Ea.)	7.50
1 No. 572 T-handle		2.25
		$61.75

Above prices are F.O.B. Evanston, Illinois.