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**CHEMSTOR®**  
**LIQUID PRESERVATIVE FOR HIGH MOISTURE**  
**CORN, SORGHUM, WHEAT, OATS AND BARLEY**  
**TO BE USED IN ANIMAL FEED ONLY**

9-27-72  
UNDER THE FEDERAL PESTICIDE  
FUNCTION AND RODENTICIDE ACT  
FOR FORTIFIED FOLSON REGISTER-  
ED TRADE NO.

**DANGER:**  
**CAUSES SEVERE BURNS**

**KEEP OUT OF REACH OF CHILDREN**

**ACTIVE INGREDIENTS:**

Organic Acids 99% Min. (19% Acetic and 80% Propionic)

**INERT INGREDIENTS:**

(Water) 1% Max.

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E.P.A. Reg No. 148-1114

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Do not get liquid or vapor in eyes, on skin, or clothing. Use in well ventilated area and do not inhale. Wear goggles, rubber gloves and protective clothing when handling ChemStor®. Keep away from heat and open flame. In case of contact, immediate<sup>1</sup> flush skin or eyes with plenty of water for at least 15 minutes. For eyes, get medical attention. After contents have been removed, drums should be washed and completely drained. Do not contaminate water by cleaning of equipment, or disposal of wastes

**IMPORTANT: BEFORE USE SEE MANUFACTURERS  
TECHNICAL BULLETIN FOR DIRECTIONS  
AND OTHER CAUTIONS**

**WARRANTIES:** Apart from the representations in the ChemStor® Product and Technical Bulletins, there's NO WARRANTY, representation or condition of ANY KIND, expressed or implied (including NO WARRANTY OF MERCHANTABILITY) concerning material sold hereunder or containers in which shipped Thompson-Hayward shall have no responsibility, whether for breach of warranty, negligence, or otherwise, for any loss, damage or injury to persons or property arising out of the use, storage or handling of ChemStor® otherwise than in strict accordance with the directions contained in the ChemStor® Technical Bulletin.

UNDER THE FEDERAL INSECTICIDE  
FUNGICIDE AND RODENTICIDE ACT  
FOR ECONOMIC POISON REGISTER  
ED UNDER NO. 148-1114

CHEMSTOR<sup>®</sup>  
LIQUID GRAIN PRESERVATIVE

TECHNICAL BULLETIN

4-4-55

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TABLE OF CONTENTS

INTRODUCTION

MOLD PROBLEMS AND THEIR CONTROL  
• Drying • Anaerobics • Chemical

CHEMSTOR<sup>®</sup> BACKGROUND

FEEDING CHEMICALLY TREATED HIGH MOISTURE GRAIN  
• Summary  
• Feed Efficiency Comparison  
• Ration Formulations

TREATING GRAIN  
ChenStor System  
Procedure

STORING GRAIN

COOLING STORED GRAIN

SAFETY AND HANDLING

## INTRODUCTION

ChemStor<sup>®</sup> liquid grain preservative is an E.P.A. Registered liquid fungicide developed for use of high moisture feed corn, sorghum, wheat, oats and barley. It is a blend of acetic and propionic acids -- which allows the farmer to store shelled corn and other high moisture cereal grains without drying or the use of air tight silos.

ChemStor<sup>®</sup> acts as a preservative by preventing the growth of molds and most bacteria in high moisture cereal grains during storage -- and is effective for the storage of cereal grains.

The purpose of this manual, is to provide a basic introduction to the general aspects of liquid preservation of high moisture cereal grains via the ChemStor<sup>®</sup> system. More comprehensive literature is available on such specific subjects as treatment of grain, storage, and comparative economics.

For further information on these and other subjects, contact your local participating ChemStor<sup>®</sup> dealer.

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MOLD PROBLEMS AND THEIR CONTROL

As is generally known, all freshly harvested grain carry many types of molds and bacteria. When these freshly harvested (moist) grains are stored in an untreated condition ... temperature, moisture and oxygen combine to generate rapid micro-organism growth, which in turn causes excessive heating, fermentation, spoilage and often, toxic byproducts.

Traditionally, there have been but two ways to control this mold and bacterial growth. Drying -- i.e. reducing the moisture content to below 15.0%. And anaerobics -- i.e. removing the oxygen supply. Both of these systems are mechanical methods of controlling spoilage -- and are effective.

DRYING

Drying grain has tended to be the most commonly used method of preserving grain, due to its relatively low cost and simplicity. However, inherent in the system is a drawback. And this is the drop in feeding efficiency created by the drying. Various reconstituting procedures have been developed recently, but these serve to cancel out the original cost and simplicity benefits.

## ANAEROBICS

Preserving grain by removing oxygen (air-tight silos) was an important advance in grain preservation and storage, when introduced several years ago. Its major contribution to the science of agriculture, was to prove the superior feeding efficiency of high moisture grain. The major drawback to the system is the relatively high capital investment required to set it up.

## CHEMICAL

The most recent development in the science of preserving grain, is a chemical one. ChemStor<sup>®</sup> liquid grain preservative is such a system. The use of ChemStor<sup>®</sup> fungicide prevents dry matter loss by stopping the germ growth, along with respiration in the seed. The major advantages of this system are that it combines the simplicity of drying, with the feeding superiority of high moisture grain.

CHEMSTOR<sup>R</sup> BACKGROUND

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The preservation and storage of high moisture cereal grains has been practiced in Europe and Canada for many years. In a desire to study the subject further, and verify the effectiveness of acid treated grain, research studies into the performance of organic acids and combinations of acids as grain preservatives were undertaken with the cooperation and participation of 14 state universities and experiment stations as well as three private research facilities.

The result of this research is ChemStor<sup>R</sup> fungicide, a practical, new method of providing safe storage for high moisture corn and other cereal grains. In 1971 ChemStor<sup>R</sup> was introduced to the agricultural community by treating 679,000 bushels of cereal grains at 192 test farms across the United States. The results, after 12 months of storage, proved effectiveness of ChemStor for the storage of cereal grains.

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FEEDING HIGH MOISTURE PRESERVED GRAIN

The feeding studies involving livestock and poultry, conducted by the State Universities and private laboratories show that chemically preserved grains are safe. Meat and milk quality are not adversely affected in any way.

Palatability and feed intake remain normal. Efficiency of feed utilization is usually superior to that of dry grain ... and is as good as, or better than that of high moisture grain stored in pits or air tight silos. The following table shows the result of several of these studies.



Average Daily Gain and Feed Efficiency of  
Acid-treated High Moisture Grain  
Compared to Dry Grain

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	<u>AVERAGE DAILY GAIN</u>		<u>FEED EFFICIENCY</u>	
	<u>lb</u>	<u>% Improvement over dry grain</u>	<u>Dry matter basis lb feed/lb gain</u>	<u>% Improvement over dry grain</u>
<u>Beef Cattle</u>				
Penn State U	3.59	7.0	7.8	4.6
Purdue University	1 2.50 2 2.56	2.5 2.0	6.1 6.8	4.9 7.0
Texas A and M U.	1 3.00 2 2.98	4.6 3.8	8.9 6.6	1.6 3.0
Univ. of Guelph	1 3.06 2 3.08	4.8 7.7	5.0 5.2	9.0 7.2
<u>Swine</u>				
Texas A and M U.	1.52	6.7	3.2	3.3
Univ. of Alberta	1.24	5.9	2.7	7.1
Univ. of Guelph	1.72	6.8		
<u>Lamb</u>				
Kansas State U.	.51	31.2	5.53	19.5
Univ. of Alberta	.58	9.4	4.21	6.0
<u>Poultry (56 day weight)</u>				
North Carolina State	.80	4.2	1.96	5.8
Univ. of Guelph	.78	-1.1	2.31	3.0
<u>LB 4% Fat Corrected Milk Per Day</u>				
<u>Dairy Cattle</u>	<u>DRY GRAIN</u>	<u>HIGH MOISTURE ACID TREATED GRAIN</u>		
McGill Univ.	49.10	50.40		
Texas A and M U.	51.30	51.61		
Univ. of Guelph	32.60	30.80		

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## References for livestock production data cited in Table

Beef Cattle

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Swine

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Bowland, J. P., 1972. Processed rapeseed treated with propionic acid as an energy and protein supplement for market pigs. 51 Annual Feeders Day Report, Dept. Animal Science, University of Alberta, pp. 1.

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PoultryUniversity of Guelph

Summers, J. D., 1972. Organic acid preserved high moisture corn for poultry. Proc. 8 Annual University of Guelph Nutr. Conf. for Feed Manuf., pp. 97.

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Gehle, M. H., 1972. Preservation of high moisture corn with volatile fatty acids. Paper, presented at Poultry Science Assoc. Meeting, August 8, 1972, Columbus, Ohio.

Dairy CattleMcGill University

Jones, G. M., 1972. Milk production by dairy cows fed propionic acid-treated high moisture shelled corn rations for complete lactations. *J. Dairy Science* 55:685A.

Texas A and M University

Lane, G. T., D. H. Bade, A. Driedger, and R. E. Leighton, 1972. Acetic acid, reconstituted sorghum grain for dairy cows. *J. Animal Science* 35: 269A.

University of Guelph

Forsyth, J. G., et al, 1972 (see above).

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IMPORTANT FEEDING NOTE

In feeding high moisture grain, it is important to account for the additional moisture content when formulating rations for livestock!

For example, 100 pounds of 14% moisture grain will weigh 116 pounds at a moisture content of 26%. (See following chart.)

Thus a typical ration consisting of 800 pounds of corn at a theoretical 14% moisture level, 150 pounds of roughage, and 50 pounds of supplement (total 1,000 lbs.) should be adjusted upward of 928 pounds corn (actual 26% moisture), with the roughage and supplement rations remaining at 150 and 50 pounds respectively. (Adjusted new total weight: 1128 pounds.)

When dairy rations are fed on a production basis, a similar adjustment for moisture should also be made, to prevent underfeeding.

WEIGHT/MOISTURE CHART

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**BEST AVAILABLE COPY**

Example:  
115 lbs. of material  
is used for 100 lbs. of  
dry material. The  
moisture content is  
13.04%

## TREATING GRAIN WITH CHEMSTOR<sup>R</sup> LIQUID PRESERVATIVE

The ChemStor System is an exclusive application method for the treatment and handling of high moisture grains. It consists of the following components:

### APPLICATOR

The applicator is designed to treat approximately 400 to 1000 bushels per hour, at 25% moisture, and is made-up of the following:

1. Hopper
2. Auger
3. Spray Chamber
4. Pump
5. Control Panel
6. Motor

The applicator weighs 450 pounds, has road-rated tires and can be maneuvered by one man. Its motor requires single phase, 220 volt AC power.

### MOISTURE METER

The moisture meter is the key component, in determining the moisture level of the grain to be treated.

### TEMPERATURE PROBE

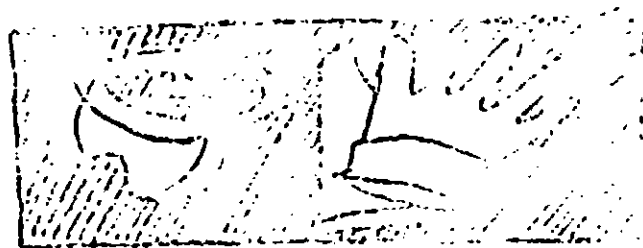
The temperature probe is used to check the temperature of stored grain throughout the storage period.

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RELATED SAFETY EQUIPMENT

Goggles to protect the eyes and rubber gloves to protect the hands are essential for safe handling of CherStor



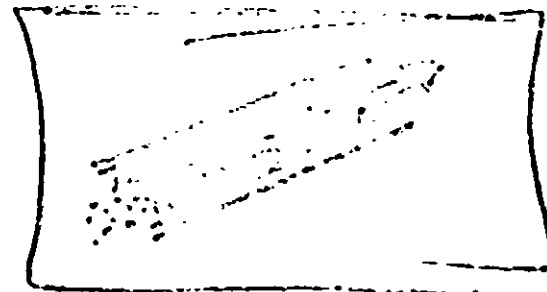
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## PROCEDURE

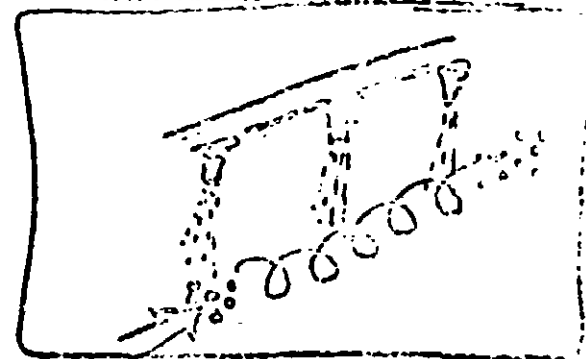
The treatment of the grain starts with the unloading of the grain into the polyethylene hopper of the ChemStor<sup>R</sup> Applicator.



Next, the grain travels up the auger, at a pre-determined speed.



As the grain moves up the auger, it passes through the spray chamber, where the correct amount of ChemStor<sup>R</sup> liquid preservative is applied automatically.



(Note: The applicator control panel has a shutdown valve that automatically stops the unit, should the supply of ChemStor<sup>R</sup> liquid run out.)

The combination of auger speed, the tumbling action of the auger, and the thoroughness of the three spray-heads, assures complete coverage of the grain to be treated.

Once the grain has traveled through the applicator, it is delivered to the farmers conveyor, and on into storage. Thus the crop need be handled only once. No further treatment is necessary.



TYPICAL CHEMSTOR APPLICATION RATES

GRAIN MOISTURE %:	15	17	19	21	23	25	27	29
CHEMSTOR, WT. %:	0.60	0.70	0.85	0.95	1.10	1.20	1.33	1.95

The three critical factors involved in properly treating any grain with ChemStor are:

Moisture of grain being treated.

The amount of grain being treated, per unit of time.

These two factors in turn, determine the third, which is:

Amount of ChemStor to be applied.

The chart below is an easy to use tool in determining the proper amount of ChemStor to be used in treating any grain.

Directions:

First of all determine the moisture level of the harvested grain, with the Moisture Meter supplied with the system. Locate this percentage on one of the upward angled lines on the chart.

Next, run a quantity of the grain to be weighed through the auger for ten (10)

seconds, and collect it in a suitable container. Weigh this sample. Repeat the run a second time. Average the two results, and find this weight on the bottom horizontal scale on chart.

By moving from this weight number straight up to where this imaginary line meets the angled line representing the moisture of the harvested grain ... and then left to the vertical scale -- (Flowmeter Setting, Gallons per minute) -- we arrive at the flowmeter setting number which will apply the proper amount (flow-rate) of ChemStor.

Example:

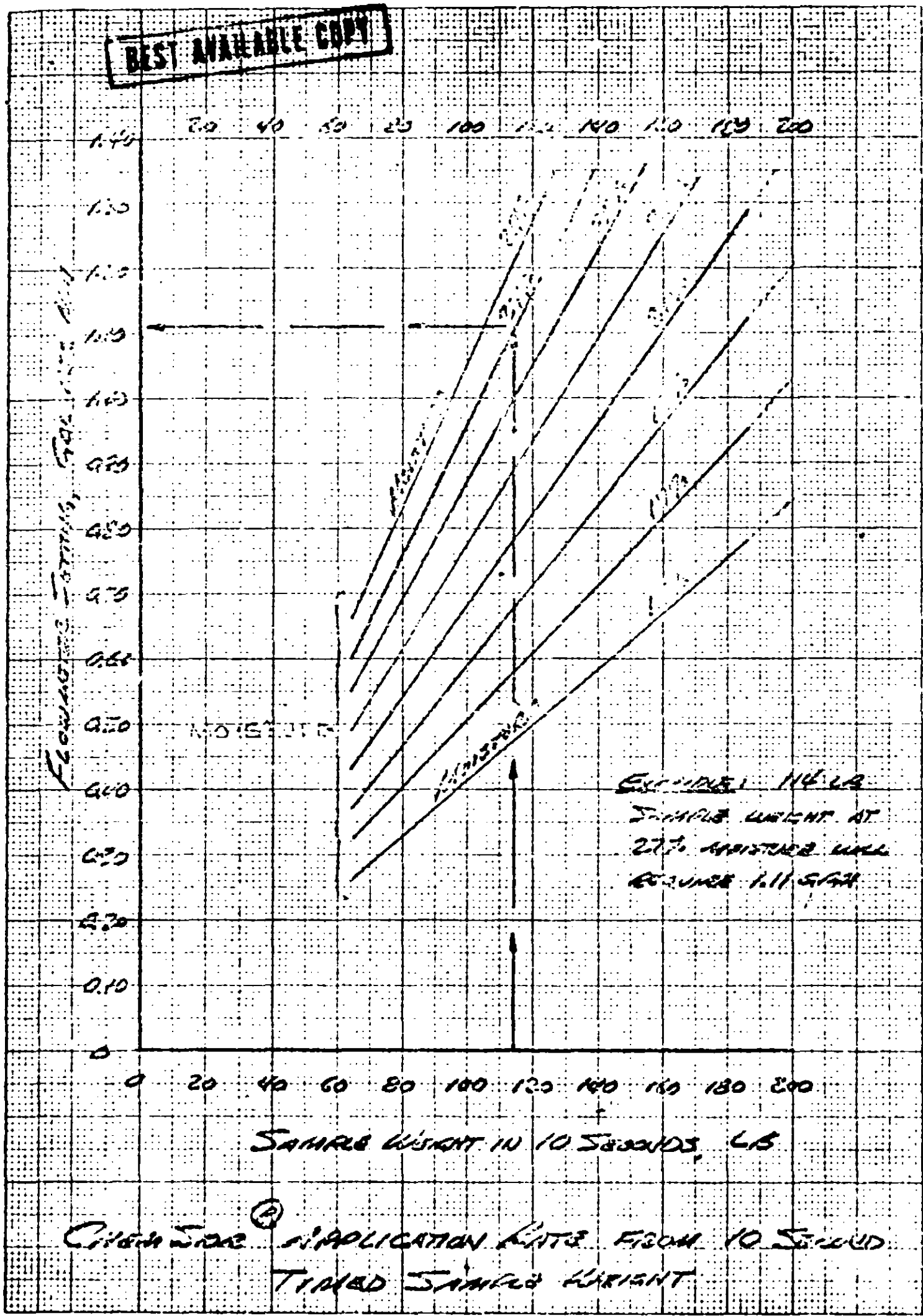
Assume a grain harvested with a moisture content of 27% ... and its weight is 114 pounds per 10 second run through the auger.

By locating the 114 pounds on the horizontal (bottom) scale ... following that line up to the 27% moisture line ... and then over to the vertical axis ... we find that the proper flow rate is 1.11 gals/min. which is then set on the flowmeter. With this setting, you are ready to run your applicator and treat your grain.

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EUGENE DIETZGEN CO  
MADE IN U. S. A.

NO. 340R-20 DIETZGEN GRAPH PAPER  
20 X 20 PER INCH



NOTE:

Even though we recommend specific treatment levels for each 2% increment of moisture, we do not recommend changing the setting for a particular storage site. In other words, grain going into any one bin should all be treated at the same level. This can be done by estimating the highest moisture grain that will be harvested and treat for that moisture level. Grain that has a higher moisture than estimated should be diverted to other storage.

IMPORTANT:

NOTE: TREATING GRAIN ABOVE THE 29% MOISTURE LEVEL IS GENERALLY NOT RECOMMENDED, AS THE COST ADVANTAGES OF CHEMSTOR<sup>R</sup> BEGIN TO DIMINISH BEYOND THAT POINT.

## STORING CHEMSTOR PRESERVED GRAIN

Good harvesting and storage practices should always be followed in the handling, treatment, and storage of ChemStor treated high moisture grain.

1. Clean storage area of dirt and old grain.
2. Protect metal and concrete surfaces. ChemStor<sup>R</sup> preservative is a mixture of weak organic acids which will react with metal surfaces causing damage to the metal and sometimes causing the grain at the metal surface to mold. To a lesser extent it also reacts with a concrete surface.
3. Know your harvesting machinery and set it properly. Clean grain stores better.
4. Treat grain as soon as possible after harvesting -- preferably within six hours. Mold growth often starts within a few hours after harvest.
5. Do not store ChemStor treated grain with untreated dry grain, as this can lead to spoilage of untreated grain.
6. Level the surface of stored grain in bins, to prevent moisture from condensing in the peaks. Leveled grain should not exceed eave height to allow sufficient ventilation space. Leave top surface of stored grain uncovered to prevent sweating.

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7. Ventilate air space over bin or silo stored grain to prevent sweating by permitting moisture laden air to escape. If head space is large enough (for example, a small pile of grain inside a shed) natural ventilation should be adequate. Forced ventilation with fans is desirable in enclosed head spaces of bins, silos, covered piles of grain, or large volumes of grain in a shed. Size the fan to provide at least one air change every three minutes. Suction fans should have aluminum blades and a totally enclosed motor. Louvered sections in the roofs of bins, silos, and sheds will also aid in ventilating the head space. All ventilating systems should be designed to keep rain and snow from entering the storage container.
  
8. Use extra care, because experience has shown that high moisture grain stored at grain temperatures above 60°F is more difficult to preserve than grain stored below 60°F.

Early harvest in some areas will result in grain entering storage at higher temperatures.

- a. Plan your feeding program to feed this grain first, and inspect the grain's temperature with the temperature probe more frequently.
- b. Avoid storing warm grains in volumes greater than 1500 to 3000 bushels.
- c. Cooling, if properly performed, can give improved keeping qualities. Where warm grain (greater than 60°-70°F) in quantities greater than 1500 bushels is stored, cooling should be done as follows:

23 of 31

- Start fans only when overnight average temperature drops to 50°F.
- Once fans are started, run continuously until grain temperature reaches 55°F. Then shut off fan. Measure grain temperature near point where air leaves stored area.

NOTE: TO AVOID MOISTURE DEPOSITION ON GRAIN, AVOID OVER AERATING.

DO NOT AERATE IN SPRING.

9. Inspect grain weekly. Observe conditions of the surface and measure internal temperature. Notify your dealer immediately if you detect a problem.

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## CHEMSTOR AND STORAGE FACILITIES

1. Concrete Silos or Bins -- To prevent pitting of concrete or cement surfaces, / a coating of Devco's No. 48201 Coal Tar Epoxy paint to the floor and lower portions of the wall is recommended. A drain in the bottom is also beneficial.
2. Galvanized or Steel Bins -- Both the acid treated grain and the vapors from the grain will react with the metal and damage the bin. Some protection is offered by covering the walls with 6-mil polyethylene. Areas exposed to vapors should be coated with coal tar epoxy.
3. Wooden Bins -- A highly recommended form of storage. Any exposed metal surfaces may be protected using coal tar epoxy paint.
4. Aluminum Bins -- Aluminum bins need no protection.
5. Buildings or Quonsets -- Protect walls and floors in contact with grain as outlined above.
6. Pits and Trenches -- Ventilation of head space in pits and trenches is difficult if they are covered with polyethylene. A roof above the pit is desirable. Polyethylene covers restrict air movement and cause moisture condensation. When grain is stored under polyethylene it may be necessary to remove the cover from time to time to ventilate, or to force ventilate by sucking air under the cover.



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All pits should be well drained. Do not cover dirt floors and walls, but instead spray them with 0.2 to 0.4 lb ChemStor<sup>R</sup> preservative per sq. ft.

7. Sheds -- Open sheds with dirt or concrete floors make good storage. Grain can be stored in piles, wooden bins, paper multiwall bins manufactured by St. Regis Paper Co., or snow fence enclosures under sheds. Snow fence should be lined with aluminum screen wire. Treat dirt floors with 0.2 to 0.4 lb. ChemStor<sup>R</sup> preservative per sq. ft.
8. Temporary Storage -- Treated grain may be temporarily stored for limited periods in uncovered piles on the ground.

2 JUNE 51

SAFETY AND HANDLING

SAFETY

ChemStor<sup>R</sup> liquid grain preservative is harmful to eyes, skin and other tissues if improperly handled. Care should be taken to avoid inhaling the vapors, and of course, it should never be swallowed.

Gloves, safety goggles or glasses and aprons should be worn at all times -- whether handling the preservative, or grain that is still wet from treating. Protective gear should be made of rubber or equivalent<sup>\*</sup> impermeable material.

A water supply should be readily available in case of contact.

FIRST AID

ChemStor<sup>R</sup> liquid preservative will not cause discomfort immediately following contact -- and thus does not give quick warning of possible burns. Therefore, speed is essential in removing any ChemStor<sup>R</sup> that has accidentally made contact with any unprotected areas. In case of accident, the following first aid procedures should be followed:

SKIN SPLASH: Immediately flush all exposed areas that were splashed with large quantities of water for at least 15 minutes. A physician should be consulted in case of severe or extensive exposure.

EYE CONTACT: Flush immediately with water for 15 minutes. Get medical attention.

Pounds of High Moisture Corn required to give equivalent dry matter of 100 pounds 14% corn

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**SWALLOWING:** If ChemStor<sup>R</sup> is swallowed, do not attempt to induce vomiting. Wash out mouth with abundant quantities of water --- then drink milk mixed with the whites of eggs. If milk and eggs are unavailable, drink as much water as possible. A physician should be called.

**CLOTHING:** All contaminated clothing should be removed immediately and washed and cleaned separately and thoroughly before being used again.

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28

GENERAL SAFETY POINTERS

Wear rubber soled shoes when treating with ChemStor<sup>R</sup>, as spilled ChemStor<sup>R</sup> liquid will be absorbed through leather soled shoes and then make contact with skin.

When the applicator is operating, keep hands away from the auger. Avoid wearing loose clothing.

Make sure the electrical system is properly grounded. When using 115 Volt power, a 3-wire, grounded system is absolutely required.

When using 230 volt power, the usual 3-wire, grounded neutral system is adequate ... but a / <sup>separate</sup> ground wire, tied directly to the chassis is recommended.

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HANDLING

ELIMINATE ALL SOURCES OF HEAT AND OPEN FLAME FROM THE TREATING AREA AND STORAGE FACILITY. DO NOT USE, POUR, SPILL OR STORE NEAR HEAT OR OPEN FLAME.

Drums of ChemStor<sup>R</sup> liquid grain preserver should be handled carefully to avoid undue stress. They should always be stored with the body plug upward.

When opening a drum, loosen the drum plug slightly (checking for internal pressure) and then proceed to open plug slowly to allow any internal pressure to vent. Pressure should never be used to discharge the contents of a drum. After the contents have been removed, drums should be washed and completely drained.

DO NOT ENTER STORAGE FACILITIES WITHOUT ADEQUATE VENTILATION!

DO NOT TREAT CORN OR OTHER CEREAL GRAINS WHICH MIGHT BE USED FOR SEED, MALTING PURPOSES, OR HUMAN CONSUMPTION!

TREATED CORN AND OTHER CEREAL GRAINS ARE TO BE USED FOR ANIMAL FEED ONLY!

Fish and wildlife cautions -- DO NOT CONTAMINATE WATER BY DISPOSAL OF WASTE OR WATER USED IN CLEANING EQUIPMENT.

DRUMS NOT TO BE REUSED FOR ANY PRODUCT OTHER THAN CHEMSTOR<sup>R</sup>.

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WARRANTEES

Apart from the representations in this bulletin, there is NO WARRANTY, representation or condition of ANY KIND, expressed or implied (including NO WARRANTY OF MERCHANTABILITY) concerning material sold hereunder or containers in which shipped. Seller shall have no responsibility, whether for breach or warrenty, negligence, or otherwise, for any loss, damage or injury to persons or property arising out of the use, storage or handling of ChemStor<sup>R</sup> otherwise than in strict accordance with the directions contained in this Bulletin.

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CHROMATOPHORE