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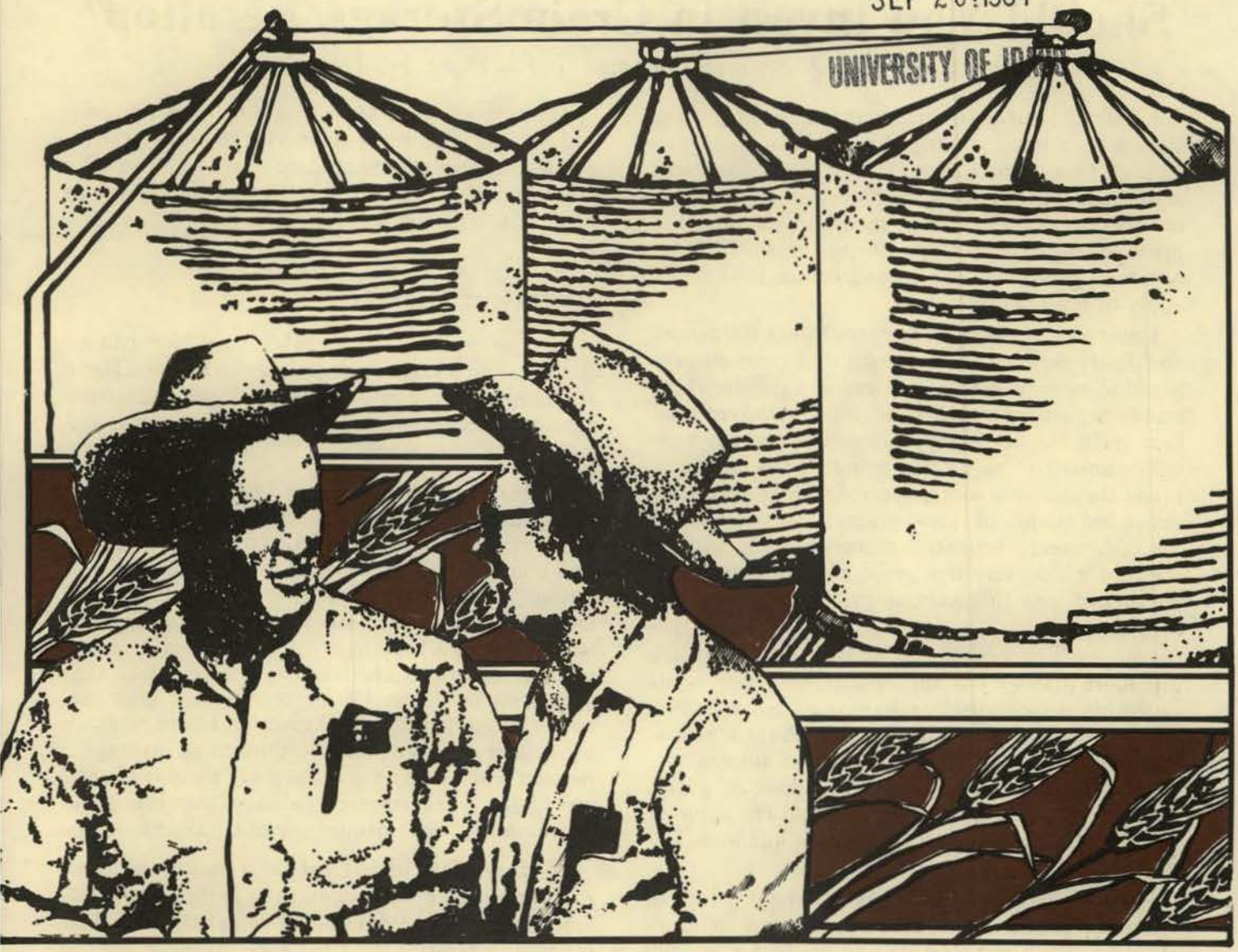
Should You Invest In Grain Storage Aeration?

J. F. Guenthner and G. R. Prigge



Cooperative Extension Service
University of Idaho
College of Agriculture

Should You Invest in Grain Storage Aeration?

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Eastern Idaho grain often comes out of grower storage at a lower quality than when it went into storage. One of the reasons for the quality problem is that many growers may not be aware of the latest technology in grain storage management. Another problem may have been misinformation; the USDA's national grain storage recommendations don't apply to high desert climates.

University of Idaho researchers James Halderson and Larry Sandvol have shown that grain storage aeration systems can reduce loss of value in wheat and barley stored in eastern Idaho. They have found that grain bin aeration equipment — which basically consists of an electric powered fan, air ducts in/on the bin floor and a control system — can improve the quality of stored grain. Losses because of insect damage, germination reduction, mold, sprouting and excessively dry grain can be reduced or eliminated with this technology.

Grain bins without aeration equipment can have encompassing temperatures of 32° F on the outside and more than 90° F in the center. These "hot" spots in the bin, which usually also have excess moisture, are where insect problems occur. Without aeration, growers often must bear the costs of fumigation, price discounts or rejection and loss of grain. Halderson and Sandvol estimate that the value of grain lost to inadequate storage in Idaho is $10 million annually.

With an aeration system growers have a tool to maintain proper, uniform temperatures in grain storages. With the cool, humid air that is readily available year-round during eastern Idaho nights growers can get the right conditions in the bins by running the fans at the appropriate time. Halderson and Sandvol recommend a system that includes electronic temperature monitors and automatic controls and that eliminates the cost and risk of human error in the timing of fan starts and stops.

Aeration systems, of course, cost money to own and operate. Growers considering investment in an aeration system should analyze whether the benefits outweigh the costs. This publication shows how to make that analysis.

Aeration Benefits

Five potential major benefits exist that can be attributed to a grain storage aeration system. These are reduced storage loss, reduced pesticide cost, reduced price discounts, reduced moisture loss and income tax advantages.

Reduced Storage Loss — The amount of grain lost in storage does not entirely depend on whether an aeration system is used. Length of storage, size and condition of the storage facility, harvest conditions, weather and owner management are all factors that influence storage loss. Some growers with small bins may have excellent storage results without aeration. Others may suffer losses that ultimately could be 100 percent if their grain becomes unmarketable. University of Idaho research by Halderson and Sandvol showed an average 5 percent loss based on grain storage surveys in eastern Idaho. Their research indicates that loss could be eliminated with proper use of aeration systems.

Reduced Pesticide Cost — Grain storage insect pests generally need temperatures in the 80s and 90s for optimal development. Temperatures below 60° F stop reproduction for most of these insects. Without aeration, grain storage temperatures are maintained in the range in which the insects thrive. The use of Malathion at bin filling time and subsequent fumigation can be used for temporary control of insects despite the temperature. Unless temperatures are lowered, however, insects will again and again infest the grain.

With an aeration system the chemical control and its costs are unnecessary. Approximate pesticide costs in 1983 were $4.00 per 1,000 bushels of grain for Malathion, $19.00 per 1,000 bushels for a liquid fumigant and $31.00 per 1,000 bushels for a pelleted fumigant.

Reduced Price Discounts — A grower whose grain does not make grade because of excessive insects may be forced to take a large price discount, especially if the grain is not inspected until it arrives in Portland. Also, even insect-free grain of excellent quality may take a slight price discount because of the poor reputation of the area in which it was grown. This, however, is hard to quantify. A grower that has taken discounts because of insects may want to include the discount in his analysis of the feasibility of an aeration system.

Reduced Moisture Loss — Grain is sold on the basis of weight. If the grain in excessively dry, it weighs less, and the grower is paid for less grain. For example, consider wheat which is sold on a 13.5 percent moisture basis. Each 1 percent moisture change causes a 1.1 percent weight change. If a grower sells 12.5 percent moisture wheat, he will be paid for only about 99 bushels instead of the 100 bushels he would have been paid for if the moisture was 13.5 percent. Growers without aeration often have excessively dry grain. Moisture content of stored grain averaged 10 percent in the Halderson/Sandvol study. Halderson estimates that an aeration system may give the grower an extra 1 percent moisture content. This is achieved by running the fans during the nights or whenever the air is more humid as well as more cool.

Income Tax Advantages — If a grower operates a profitable business with taxable income, an investment in aeration equipment will provide tax benefits. Investment tax credit is a benefit that will be realized in the year of purchase. Each dollar of investment credit will reduce the grower's tax liability by one dollar, regardless of his income tax bracket. Growers have the option to claim investment credit of either 8 percent or 10 percent with different depreciation rules. If the grower chooses the 10 percent option on equipment costing $1,000, his investment credit is $100, which reduces his tax liability also by $100.

The costs of owning and operating an aeration system — e.g. depreciation, interest, repairs, power — are tax deductible and thus also provide tax benefits to the grower. A dollar of expense deduction, however, is not as valuable as a dollar of investment credit. The value of an expense deduction depends on the grower's net income and corresponding marginal tax bracket. For example, if a grower is in the 30 percent tax bracket, each dollar of expense deduction yields 30 cents in tax savings. Appendix Tables 1 and 2 give marginal tax brackets for Idaho farmers.

Aeration Costs

The annual cost of an aeration system can be classified under two categories — overhead costs and operating costs. Overhead costs are a fixed amount each year regardless of the use of the system. Indeed, overhead costs are incurred even if the system isn't used. Overhead costs include depreciation, interest on investment, property taxes and insurance. Operating costs are incurred as the system is used and include electricity, labor and repairs. The following is a brief explanation of overhead and operating costs.

Overhead Costs

1. **Depreciation** — The cost or purchase price of an asset that can be used for more than 1 year should be spread over the years it is used. Depreciation is a bookkeeping entry that accounts for the loss in value of the asset over the years. Assuming that the value of the aeration system will be zero at the end of its useful life, depreciation can be calculated by the following formula:

Annual depreciation = Purchase price ÷ Years used

The method of depreciation calculation in the above formula is based on economic value and may be quite different than depreciation methods allowed for federal income tax purposes.

2. **Interest on Investment** — It costs money to use money. The purchase of an aeration system or any asset ties up money. If the money was borrowed, its cost is the interest rate of the loan. If the money invested in the asset came from the business instead of a lender, the foregone earnings of the capital can be considered a cost. The capital could have been invested in some other aspect of the business or in something else such as the money market. Since many asset purchases consist of equity capital in the form of a down payment and loan capital, an average rate may be useful for calculation purposes. Once the interest rate is determined, the annual interest cost is simply calculated by multiplying it by the average investment. Again assuming a zero ending value, the formula is:

Annual interest cost =
(Interest rate) × (Purchase price ÷2)

3. **Property Taxes** — Growers in Idaho must pay property taxes on farm equipment. The amount varies between tax districts depending on valuation procedure and the mill levy. One percent of the pur-

chase price may be a reasonable estimate for purposes of this analysis.

4. **Insurance** — Most growers choose to insure their assets against the risk of theft, vandalism, fire and other disasters. The cost of insurance is highly variable. Because of the way some policies are written, you may not be able to determine the actual cost of insuring each asset. One percent of the purchase price may be a ballpark figure for those who don't have good access to insurance cost information.

Operating Costs

1. **Electricity** — The electricity required to operate the fan in the aeration system is an operating cost. The electric motor on the fan may range from ¼ hp to several hp depending on the size of the storage facility. Annual electricity costs can be calculated by the following formula:

Electricity cost = (kwh) × (Cost per kwh)

A 1 hp motor uses about 1 kw per hour of use. The fan may operate 200 to 300 hours during a typical storage season.

2. **Labor** — Often when an asset is purchased, labor costs increase because additional labor is needed to operate the new equipment. Other assets may introduce a new technology that requires less labor and actually reduce labor costs. The electronic aeration system recommended by Halderson and Sandvol is probably a labor saving device. Some growers, however, that previously ignored their grain storage may have slightly higher labor costs because they may have someone personally check on the storage system on a regular basis. Also, a slightly higher labor time may be required to prepare, fill and unload a storage with aeration.

3. **Repairs** — Repair costs may vary substantially between growers and systems and, therefore are quite difficult to estimate. A further complication is that annual repair costs may be quite small in the early life of the asset but increase dramatically as the asset ages and reaches the end of its useful life. Halderson states that 1 to 2 percent of the purchase price may be a reasonable estimate for annual repair costs.

The Analysis Procedure

A worksheet has been constructed to analyze the economic feasibility of aeration systems. The variables that are necessary for analysis will differ among growers. The analysis results may be substantially different among growers, so individuals are encouraged to use the blank worksheet in the Appendix to analyze their own situation.

Worksheets are easier to use and to understand when an example is presented. Although the variables and the result in the following example are realistic, they may not be representative of a particular farm.

Example Farm

1. Background information

   a. Aeration system costs

Power installation	$ 50
Ducts	150
Fan	300
Control system	50
Installation labor	50
	$600

   The grower expects that he can use the system for 20 years.

   b. Capacity of storage = 5,000 bu

   c. Interest on investment = 15%. This is the interest rate that the PCA has been charging the grower.

   d. Annual cost for property tax and insurance is estimated to be 2 percent of the cost of the aeration system.

   e. Grower's marginal tax rate = 40%. The grower is not incorporated and expects an average net annual income of about $25,000 to $30,000. Appendix Table 1 indicates a marginal tax rate of 40 percent for this income level. A marginal tax rate of 40 percent means that for each additional dollar of income, the grower keeps 60 cents and must give 40 cents to the government. Also, for each additional dollar of deductible expense, the grower saves 40 cents on his tax bill.

   f. Estimated grain price = $4.00 per bu

   g. Estimated storage loss because of not having aeration = 3%. This is the average loss from insect damage, germination reduction, mold and sprouting that the grower estimates is caused by not aerating and cooling his storage. The 3 percent estimate is for grain stored from harvest until April or May. Storage periods of different lengths would mean different expected losses. The grower feels that he has managed his storages well in the past so that his losses have been less than the 5 percent estimated by Halderson and Sandvol.

   h. Reduced pesticides cost = $120. This includes the cost of Malathion applied at bin filling and a liquid fumigant during the storage season. With an aeration system, these costs are avoided.

i. Average price discount for storage without aeration = 0. The grower realizes that the risk of a price discount for poor quality grain is much higher if his storage doesn't have aeration. He feels, however, he has managed his stored grain well in the past and wants to see if aeration is feasible even if it doesn't affect the grain price.

j. Estimated moisture difference = 1%. The grower has been selling grain out of storage in the 11 to 12 percent moisture range. He estimates that an aeration system will add 1 percent moisture to the grain since the fans will add humid nighttime air to his storage. This will increase the weight of grain for which he is paid.

k. Electricity costs = $7. The grower estimates that his ¾ hp aeration fan will run 300 hours during the storage season. His cost of electricity is 3 cents per kwh. The calculation for his annual electricity cost is:

$$¾ \times 300 \times .03 = \$6.75$$

l. Increased costs = $50.00. The grower estimates that about 10 extra hours of labor will be required to check on the system during the storage season. His cost of labor is $5 per hour.

m. Repair costs = $9. Since the grower has never owned an aeration system, he doesn't have a good idea of what maintenance and repair costs will be. As an estimate, he guesses that 1.5 percent of the original cost will be spent each year on the parts and labor for maintenance and repair.

2. Interpretation of analysis

The analysis indicates that the aeration system in this example is a profitable investment. Line 29 of the worksheet shows that the aeration system's onetime investment of $600 is expected to add $470 to aftertax income during each of the next 20 years. Although some of the estimated variables may be in error, the $470 may be on the conservative side. That is, the aeration system may actually give a much higher aftertax return. Line 25 of the worksheet shows that the annual overhead and operating costs are 3 cents per bushel. A price discount for poor quality grain, which was not included in this analysis, may alone more than pay the 3 cent cost.

Summary

This publication provides growers with a means of analyzing an investment in a grain storage aeration system. Although the example showed that the investment is profitable, that does not imply that it will be profitable for all growers in all cases. Growers are encouraged to use the blank worksheet and their own assumptions to analyze the investment for their farm.

The University of Idaho Cooperative Extension Service has developed a computer program that allows growers to use the worksheet on an Apple microcomputer. Growers can use the system in the Extension county agent's office or purchase the program for use on their own microcomputer.

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The Authors

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WORKSHEET
Economic Analysis of Grain Storage Aeration for an Example Farm

Investment Information

1.	Aeration system price	$ 600	(1)
2.	Bushels of grain stored in bin annually	5,000	(2)
3.	Useful life of aeration system	20 yrs	(3)
4.	Interest rate on aeration system investment	15%	(4)
5.	Annual cost of aeration system, property taxes and insurance expressed as a percent of purchase price	2%	(5)
6.	Grower's marginal tax rate	40%	(6)

Annual Benefits

7.	Estimated grain price per bushel	$ 4.00	(7)
8.	Estimated storage loss without aeration	3%	(8)
9.	Benefit from reduced storage loss: line 2 × line 7 × (line 8 ÷ 100)	$ 600	(9)
10.	Benefit from reduced pesticide cost	$ 120	(10)
11.	Average price discount for grain stored without aeration	$ 0	(11)
12.	Benefit from reduced price discount: line 2 × line 11	$ 0	(12)
13.	Estimated moisture difference between storages with and without aeration	1%	(13)
14.	Benefit from reduced moisture loss: line 2 × line 7 × line 13 × 1.1	$ 220	(14)
15.	Total annual benefits: line 9 + line 10 + line 12 + line 14	$ 940	(15)

Annual Costs

16.	Depreciation: line 1 ÷ line 3	$ 30	(16)
17.	Interest on investment: (line 1 × .5) × (line 4 ÷ 100)	$ 45	(17)
18.	Taxes and insurance: (line 5 ÷ 100) × line 1	$ 12	(18)
19.	Total annual overhead costs: line 16 + line 17 + line 18	$ 87	(19)
20.	Electricity costs per year	$ 7	(20)
21.	Change in grain storage labor costs	$ 50	(21)
22.	Repair costs per year	$ 9	(22)
23.	Total annual operating costs: line 20 + line 21 + line 22	$ 65	(23)
24.	Total annual costs: line 19 + line 23	$ 152	(24)
25.	Cost per bushel/year: line 24 ÷ line 2	$ .03	(25)

Investment Analysis

26.	Net income before taxes: line 15 – line 24	$ 788	(26)
27.	Net income after taxes: ((100 – line 6) ÷ 100) × line 26	$ 473	(27)
28.	Average annual investment credit: (line 1 × .1) ÷ line 3	$ 3	(28)
29.	NET INCOME: line 27 + line 28	$ 470	(29)

APPENDIX TABLE 1
1984 Marginal Tax Rates Idaho Farm Couple Filing Joint Return

Total taxable income	Marginal federal income tax rate	Federal self-employment tax rate	Marginal state income tax rate	Total marginal tax rate*
	(%)	(%)	(%)	(%)
0 to $ 3,400	0	9.4	0	9
3,400 to 5,500	11	9.4	2	22
5,500 to 7,600	12	9.4	4	25
7,600 to 9,400	14	9.4	4.5	27
9,400 to 11,900	14	9.4	5.5	28
11,900 to 13,400	16	9.4	6.5	31
13,400 to 16,000	16	9.4	7.5	32
16,000 to 20,200	18	9.4	7.5	34
20,200 to 24,600	22	9.4	7.5	37
24,600 to 29,900	25	9.4	7.5	40
29,900 to 35,200	28	9.4	7.5	43
35,200 to 37,800	33	9.4	7.5	47
37,800 to 45,800	33	—	7.5	38
45,800 to 60,000	38	—	7.5	43
60,000 to 85,600	42	—	7.5	46
85,600 to 109,400	45	—	7.5	49
109,400 to 162,400	49	—	7.5	53
over 162,400	50	—	7.5	54

*State income tax is a deductible expense in federal income tax calculation. Federal self-employment tax is not. The calculation formula is F + (1 – F) S + E, where F = Federal rate, S = State rate and E = Self employment rate. Total marginal tax rates were rounded to the nearest whole number.

APPENDIX TABLE 2
1984 Marginal Tax Rates Idaho Farm Corporation

Total taxable income	Marginal federal income tax rate	Marginal state income tax rate	Total marginal* tax rate
	(%)	(%)	(%)
0 to $ 25,000	15%	6.5%	20%
25,000 to 50,000	18	6.5	23
50,000 to 75,000	30	6.5	35
75,000 to 100,000	40	6.5	44
over 100,000	46	6.5	50

*The calculation formula is F + (1 – F) S. Total marginal tax rates are rounded to the nearest whole number. The totals do not include Social Security tax liabilities or income tax liabilities for the owner's salary paid by the corporation.

WORKSHEET
Economic Analysis of Grain Storage Aeration

Investment Information

1. Aeration system price ..... $ _____ (1)
2. Bushels of grain stored in bin annually ..... _____ bu (2)
3. Useful life of aeration system ..... _____ yr (3)
4. Interest rate on aeration system investment ..... _____ % (4)
5. Annual cost of aeration system, property taxes and insurance expressed as a percent of purchase price ..... _____ % (5)
6. Grower's marginal tax rate ..... _____ % (6)

Annual Benefits

7. Estimated grain price per bushel ..... $ _____ (7)
8. Estimated storage loss without aeration ..... _____ % (8)
9. Benefit from reduced storage loss: line 2 × line 7 × (line 8 ÷ 100) ..... $ _____ (9)
10. Benefit from reduced pesticide cost ..... $ _____ (10)
11. Average price discount for grain stored without aeration ..... $ _____ (11)
12. Benefit from reduced price discount: line 2 × line 11 ..... $ _____ (12)
13. Estimated moisture difference between storages with and without aeration ..... _____ % (13)
14. Benefit from reduced moisture loss: line 2 × line 7 × line 13 × 1.1 ..... $ _____ (14)
15. Total annual benefits: line 9 + line 10 + line 12 + line 14 ..... $ _____ (15)

Annual Costs

16. Depreciation: line 1 ÷ line 3 ..... $ _____ (16)
17. Interest on investment: (line 1 × .5) × (line 4 ÷ 100) ..... $ _____ (17)
18. Taxes and insurance: (line 5 ÷ 100) × line 1 ..... $ _____ (18)
19. Total annual overhead costs: line 16 + line 17 + line 18 ..... $ _____ (19)
20. Electricity costs per year ..... $ _____ (20)
21. Change in grain storage labor costs ..... $ _____ (21)
22. Repair costs per year ..... $ _____ (22)
23. Total annual operating costs: line 20 + line 21 + line 22 ..... $ _____ (23)
24. Total annual costs: line 19 + line 23 ..... $ _____ (24)
25. Cost per bushel/year: line 24 ÷ line 2 ..... $ _____ (25)

Investment Analysis

26. Net income before taxes: line 15 – line 24 ..... $ _____ (26)
27. Net income after taxes: ((100 – line 6) ÷ 100) × line 26 ..... $ _____ (27)
28. Average annual investment credit: (line 1 × .1) ÷ line 3 ..... $ _____ (28)
29. NET INCOME: line 27 + line 28 ..... $ _____ (29)

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