UNIVERSITY OF IDAHO
AGRICULTURAL EXPERIMENT STATION
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Prolonging Plowshare Service

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Plowshare prepared for alloy treatment and treated plowshare in special vise.

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UNDER the dry-farming conditions found in Idaho it is often necessary to plow when the ground is very dry and hard. This condition and the type of soil encountered have resulted in a relatively short plowshare life and necessitated the frequent sharpening of shares. The frequency of sharpening varies from every half day to every other day, averaging about a day and a half for severe conditions where a service life of 15 to 20 days is obtained from each share. In some cases the cost of servicing the plowshare has been as much as 20 per cent of the total plowing cost.

In the past the plow manufacturers have recommended various types of shares for specific conditions, cast chilled iron shares being recommended for abrasive soils. In soils which require the use of steel shares, a new method has been developed to prevent excessive wear. This method consists of applying an alloy to the wearing surface of the cutting edges of the steel shares. It is not recommended, however, for use on the cast chilled iron shares. In general, the materials used are patented alloys; the one which was used in the trials made by the Department of Agricultural Engineering was a nonferrous ternary alloy of tungsten, chromium, and cobalt which comes in the form of a welding rod and is applied to the treated surface of the share by means of an oxy-acetylene torch.†

Some of the characteristics of this alloy are extreme hardness, freedom from rust, and a very high resistance to abrasion. Alloy treatment for the protection of wearing surfaces was developed first in industry; its application to agricultural tools has been comparatively recent.

This alloy treatment has been applied to the hammer faces of the rotors in hammer-type feed mills, concave and cylinder teeth in combines and threshing machines, steel plowshares, chisel points, harrow teeth, and various other types of tillage tools. The greatest economic benefit, however, appears to be from the application of the alloy to plowshares. The results reported in this bulletin were obtained from trials in which three outfits plowed 200 acres. For the first trial, which was made in the spring, one treated share was placed between two untreated shares on a tractor gang plow and a record kept of

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† The trade name of this alloy is "Stellite," made by the Haynes Stellite Company, Kokomo, Indiana.

the operation of the plow. In the fall two outfits were selected, one a four-bottom tractor gang plow and the other a three-bottom gang plow drawn by horses. Record was taken of the maintenance required for the shares before and after the

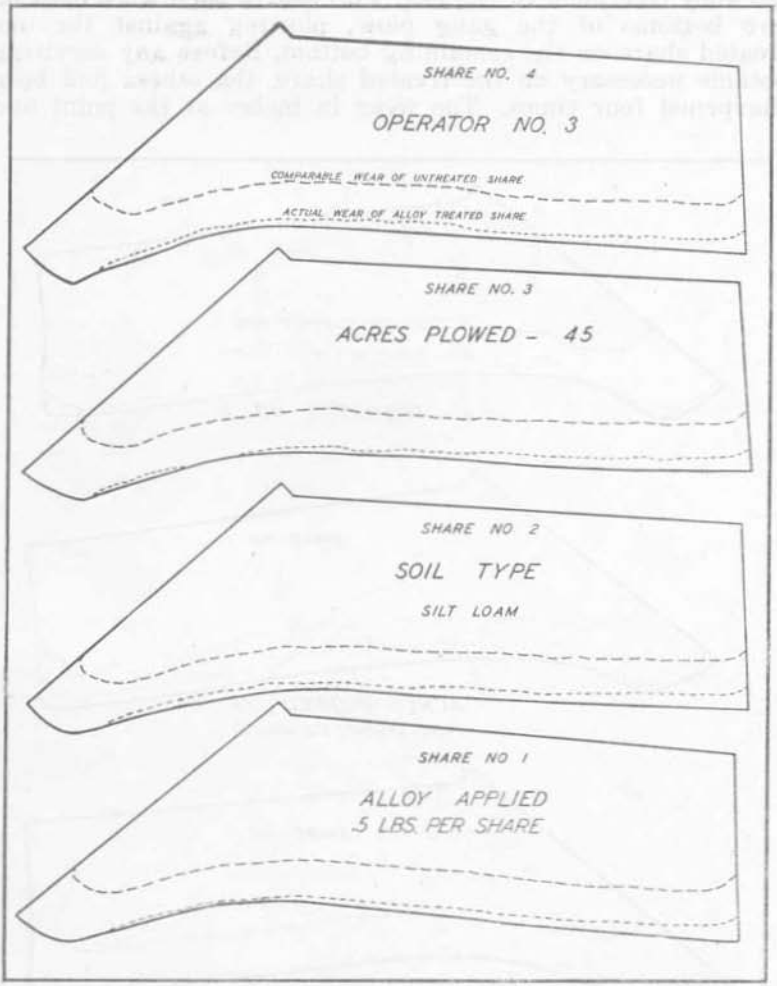

Fig. 1.—Plowshare outlines showing comparable wear of untreated shares with actual wear of alloy-treated shares.

alloy treatment. The soil was dry, and in the case of the horse-drawn gang plow conditions were very severe. The soil was composed of decomposed granite rock. The exact outline of each share was made before it was first put into service and after it was taken off for treatment, as shown in Figs. 1 and 2.

In the first test with the single share one-quarter pound of alloy was applied. The plow was used in Palouse clay loam, plowing 7 to 8 inches deep and averaging 10 acres per day for the outfit. The original shares were identical except for the alloy treatment of the one. Two shares each were used on two bottoms of the gang plow, plowing against the one treated share on the remaining bottom. Before any servicing became necessary on the treated share, the others had been sharpened four times. The wear in inches at the point and

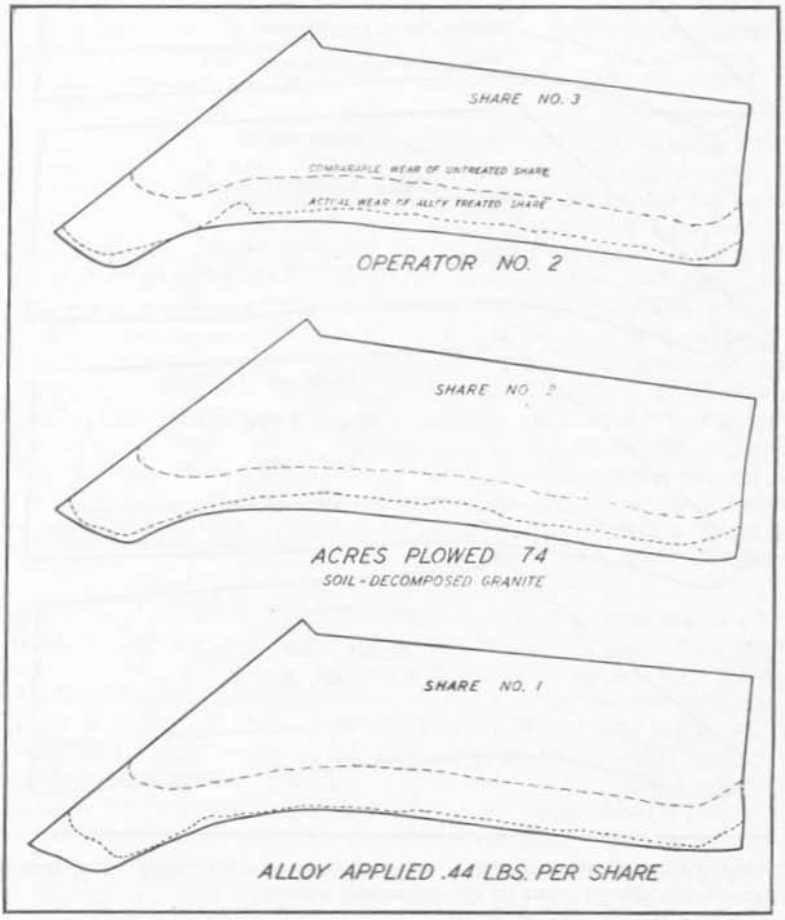

Fig. 2.—The uneven wear shown on share No. 3 was due to a thin spot in the initial alloy treatment.

cutting edge of the treated and untreated plowshares and the wear ratio are shown in Table I.

TABLE I.

Wear in Inches at Point and Cutting Edge of Plowshares.

	Wear per acre at point in inches	Wear per acre on cutting edge in inches
Steel share, alloy treatment	.0015	.0055
Steel share, no treatment	.0085	.0222
Wear ratio	5.66:1	4.02:1
Wear ratio, total mean	4.84:1	

The ground was very dry during the second and third tests, and required an adjustment of a three quarters of an inch "suck" to keep them in the ground. The alloy treatment used was one-half pound per share.

Complete records were obtained in the tests in which the plow was drawn by horses. Before the alloy treatment was used the shares were sharpened and pointed every other day at a cost of 43.8 cents per acre. After treatment with forty-four hundredths pounds of alloy per share, 74 acres were plowed at a cost of 16.3 cents per acre for the treatment. (Fig. 2). If the time and labor spent changing shares and taking them to town to be sharpened is considered along with the better performance of the plow and the decreased depreciation due to the greater wear on the untreated shares, the saving in plowing costs is between 30 and 50 cents per acre in favor of the alloy treatment.

Method of Application.

If the greatest benefit is to be obtained from the use of the alloy treatment, the technique of application must be carefully studied and followed. All of the blacksmithing work on the plowshare should be taken care of, making sure that the share adjustments are suited to the soil in which the plow is to be used. On plowshares that are to be used in very dry, hard ground, it may be necessary to increase the suction of the point just a little more than would be required on an untreated share. After the sharpening has been completed and the adjustments checked, the surface of the share to which the alloy is to be applied should be ground until bright. Grinding is recommended because it is only by grinding that all of the rust, scale, and grease can be removed from the share. This grinding must be thorough, because any scale left on the surface of the share will tend to prevent the fusion of the alloy and the plowshare steel.

After the share has been prepared, it should be placed in a

vise or blocked into position on a welding table at such an angle that the molten alloy will flow freely over the surface being treated and at the same time prevent loss of the material by running off the share.

The process of applying the alloy is similar to brazing, the only difference being that the alloy rod is substituted for the brass. A medium- or a large-sized oxy-acetylene torch tip is used with the torch adjusted to give a carbonizing or luminous flame approximately 1 inch in length. This type of flame is used to prevent oxidation of both the alloy and share metal and thus facilitate fusion of the two. The share should be heated to a dull red over the area that is to be coated. After this heat is obtained, the alloy rod is introduced into the flame where it strikes the share and both are heated until fusion results. Considerable skill is required in the manipulation of both the rod and torch in order to secure a smooth, even application of the alloy.

A one-half to three-quarters-inch width coating of the alloy is laid on the under side of the blade of the coated edge of the share and the point is tipped on the top, bottom, and land side.

When applying the torch to the edge of the share, there is some danger of burning the steel and for this reason it is recommended that the flame be directed toward the thicker part of the metal, or at least parallel to the edge being treated. It is a good practice to apply the flame at least one-half inch from the edge of the share which will then be heated by conduction.

It is essential to have a sufficient length of welding rod to completely treat the share because the application must be carried through without a break. When the torch is first applied to the share it will be noted that the scale formation resulting from the oxidation of the steel tends to prevent the fusion of the alloy and the plowshare steel. Some skill is required in lifting this scale and in securing the desired results.

For spring plowing a very light application of approximately one-fifth to one-fourth pound of alloy for a 14-inch share should be made. Extreme care should be used in the process because it is desirable to have the alloy flow on smoothly. Any roughness on the share edge tends to cause dirt to adhere to it and gives further difficulty with damp straw or weeds. For stony ground do not attempt to apply the alloy beyond the edge of the share because the material is very hard and brittle. If the plow is used where stones are likely to strike the edge, which is not supported by the tough steel of the share, it will chip off like glass and consequently be of little value.

For dry, hard plowing a heavy coating of one-third to one-half pound of alloy on a 14-inch share is recommended. Under this condition it is not necessary to be so careful about the

evenness of the job because the rough edges or high spots are soon worn down. The life of plowshares operating under this condition may be prolonged by building the alloy tip one-fourth to three-eighths inch past the share steel, thus placing all of the wearing surfaces on the alloy steel. A carbon block or fire brick may be used in extending the tip. It is essential that the alloy be laid on the wearing surface transverse to the direction of motion in order that the movement of the soil over the edge of the share will not produce grooves in the metal and eventually cut into the plowshare point after the alloy has worn off.

The alloy treatment of plowshares has been found especially suited to conditions where it costs 50 cents for sharpening the share and where it is necessary to change the share every half-day. The cost of the alloy treatment varies with the skill of the workman and with the amount of alloy applied. An analysis of the cost of a typical initial application of the alloy is shown in Table II.

TABLE II.

Initial Treatment.

Sharpening of share		$0.50
Grinding and preparation of share, 8 minutes	@ $1.50 per hour	0.20
Application of alloy, 37½ minutes		0.94
Alloy material, 1/3 pound	@ $4.00 per pound	1.33
Oxygen, 200 cubic feet	@ $4.00 per tank	0.11
Acetylene	@ $10.00 per tank	0.27
Total		$3.35

The above results require some skill on the part of the torch operator, but after a little practice a good welder should be able to duplicate the above results as no attempt was made to hurry the operation or to skimp on material.

A second treatment of the plowshare can be made at approximately one-half of the above figure and under normal conditions this second treatment brings the plowshares back to their original condition. When this practice is followed it is essential that the second application be made before any blacksmithing of the share becomes necessary.

Second Treatment.

Application of the alloy, 30 minutes		$ 0.75
Alloy material, 1/10 pound	@ $ 4.00 per pound	0.40
Oxygen	@ $ 4.00 per tank	0.07
Acetylene	@ $10.00 per tank	0.28
Total		$1.50

The acceptance of the alloy treatment of plowshares depends largely upon the availability of a competent welder. The cost of the alloy, which is $4.00 per pound, encourages the

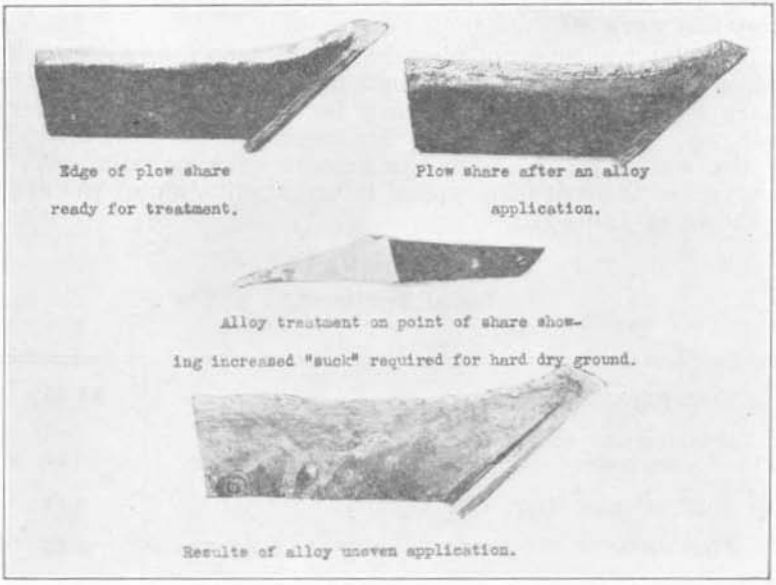

Fig. 3.—Showing edge of plowshare ground ready for alloy treatment, treated share, increased "suck" required for hard, dry, ground, and the results of uneven application.

welder to apply the minimum amount, which for commercial practice averages from one-sixth to one-fifth pound for the 14-inch shares. The rate charged for the alloy treatment varies for the different shops, a typical schedule being as follows:

12-inch share, 1/6 pound of alloy	$ 2.25
14-inch share, 1/5 pound of alloy	2.50
16-inch share, 1/4 pound of alloy	3.25

Field observations made in a small welding shop that treated an average of 150 shares each year checked closely with the results of the trials reported in this bulletin. The single alloy treatment resulted in a service life of from 100 to 200 acres per share, depending chiefly on the soil conditions and the care with which the alloy treatment was applied to the share.