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# THE MOBILE BARK BLOWER: AN EVALUATION OF PERFORMANCE AND COSTS

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# THE MOBILE BARK BLOWER: AN EVALUATION OF PERFORMANCE AND COSTS


## ABSTRACT

A custom-built bark blower truck (MOBLOW) developed in Oregon was tested for its effectiveness in applying bark mulches, sawdust, and shavings in the eastern United States. Tests determined the bark blower's performance and cost in mulching grass-legume seedings and shrub beds with 10 bark products or wood residues. Bark blower trucks built to MOBLOW specifications can effectively apply pine and hardwood bark products, sawdust, and wood shavings, but cannot handle unprocessed bark residues. Blower trucks can be used to blow shredded bark, sawdust, and shavings into barns, cattle sheds, poultry houses, show rings, and corrals, and to deliver hogged fuel.



**Keywords:** Wood residue utilization, bark products, mulching equipment, erosion control, revegetation, animal bedding, hogged fuel.

THE INCREASING USE of wood and bark residues has resulted in a need for specialized equipment to process, transport, and deliver these materials. Studies have shown that there is a critical need for such equipment to apply shredded bark mulch more efficiently over grass-legume seedings on highway roadsides and surface mines *(Sarles and Emanuel 1976; Yocom and others 1971).*

The horticultural market for bark products depends heavily on the availability and price of polyethylene bags; most of the bark industry's product is packaged and shipped to market in them. Made from petroleum, the bags have nearly doubled in price since 1973 and cost one-fourth to one-third of the wholesale price of bark, f.o.b. plant. Obviously, an efficient bulk-delivery system could improve the marketing of horticultural bark and other bark products, and help lower bark prices.

Several years ago, a special blower truck for delivering sawdust in bulk to fuel customers was developed by Rexius Fuel Service, Eugene, Oregon.[1] Today, that firm uses a fleet of improved blower trucks to transport, deliver, and apply horticultural bark products, sawdust, shavings, and organic soil conditioners *(Rexius 1971).* Such equipment is virtually unknown in the eastern United States.

After seeing the blower trucks operate, we concluded that the machine could be used in the East and that it might help enlarge the market and increase sales of bark mulch, soil conditioners, and other wood residues. Landscape contractors might use the bark blower truck to deliver bulk quantities of bark and blow it on shrub beds and gardens, and seeding contractors might use the truck to deliver and blow large volumes of shredded bark mulch over roadside and surface-mine seedings.

This unit might also be used to apply shredded bark, sawdust, and shavings in barns, cattle sheds, poultry houses, show rings, and corrals, and to deliver hogged fuel to customers who fire furnaces and boilers with wood residues.

To find out how well blower trucks can handle and apply hardwood and pine barks and wood residues in the East, the Forest Products Marketing Laboratory purchased one for testing.

## THE MOBILE BARK BLOWER

The mobile bark blower (MOBLOW) is a custom-built truck designed for dumping and blowing wood residues and bark products (fig. 1). Though specially built, its components are standard and readily available (Appendix). MOBLOW includes a cab and chassis with tandem rear axle; two power take-offs; a 30-cubic-yard truck box with a hydraulically-operated front bulkhead and top-mounted rear door; a high-pressure rotary blower; a rotary airlock with injector tee; a hydraulic system consisting of an oil reservoir, a pump, two orbital motors, and controls at two positions; and ten 12-foot lengths of 4-inch flexible metal hose fitted with quick couplers (fig. 2).

MOBLOW is versatile and can transport a large volume of bulky, low-density materials; dump any or all of its load, with full control when the moveable front bulkhead is advanced; and blow bark mulches, soil conditioners, sawdust, and shavings up to 125 feet from the truck through coupled lengths of hose. A two-man crew can perform these operations. One operates the blower, bulkhead, and airlock controls (from the rear control panel), and feeds material into the rotary airlock; the other handles the hoses and directs the stream.

[1]The use of trade, firm, or corporation names in this paper is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the Forest Service or the U.S. Department of Agriculture of any product or service to the exclusion of others that may be suitable.

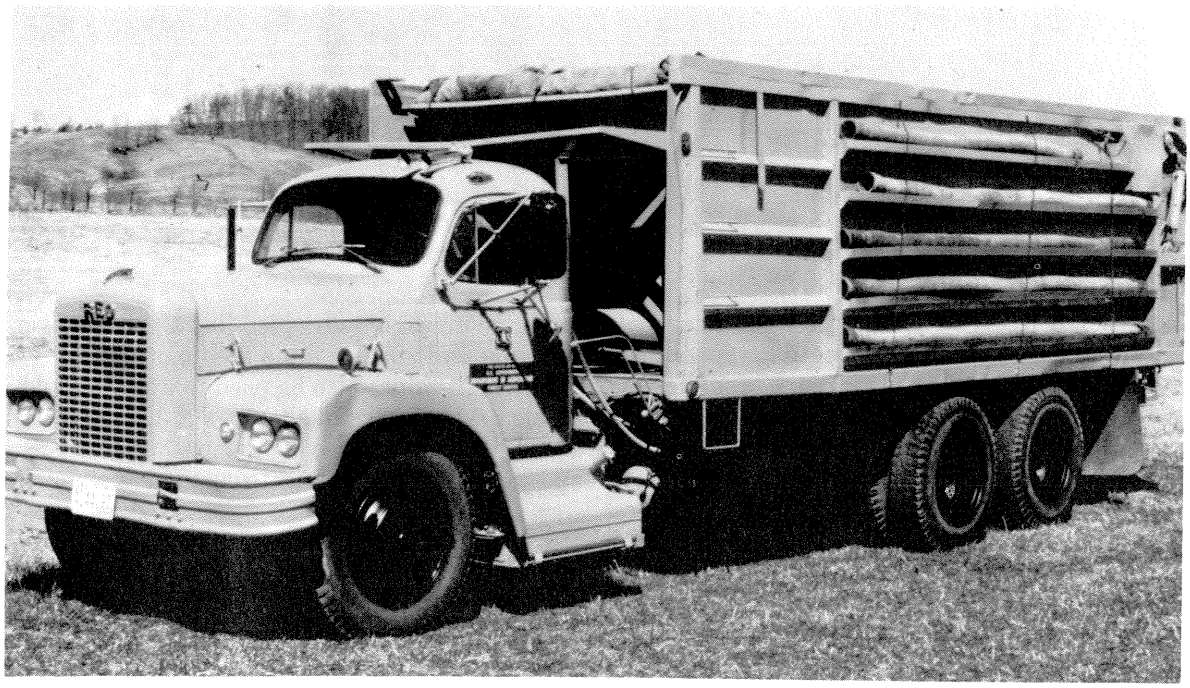

**Figure 1.—The mobile bark blower (MOBLOW) is a heavy-duty, large-capacity truck equipped with special machinery for dumping and blowing wood residues and bark products.**

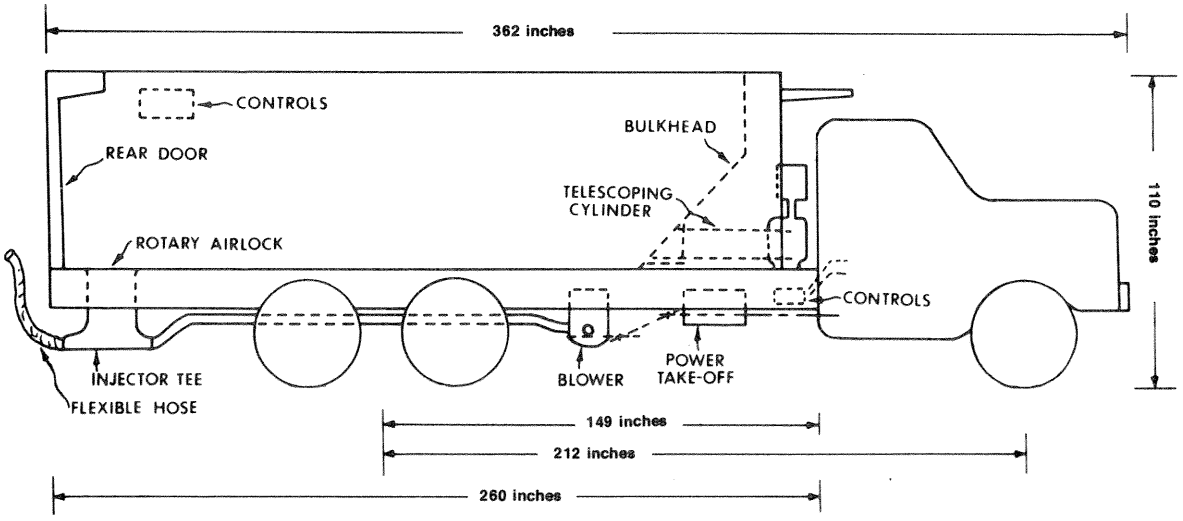


**Figure 2.—MOBLOW dimensions and special machinery.**

## STUDY METHODS

The study was conducted in four parts: (1) blowing trials of 10 bark products or wood residues; (2) application of shredded bark on two mulching jobs; (3) determination of application rates; and (4) estimation of mulching costs.

*Blowing trials.*—A large variety of bark products and wood residues are available in the East for landscaping, erosion control, and animal bedding. Our blowing trials determined which ones could be fed into the rotary airlock, metered into a high-pressure air stream, and blown through the hoses.

Because of the interest in shredded hardwood barks for erosion control and revegetation, we tested bark mulches from four processors. Pine barks are readily available in the East; we tested five grades that were obtained from two processors. We screened most materials to determine their distribution of particle sizes (by weight) (table 1).

*Mulching trials.*—In cooperation with the Roadside Development Division, West Virginia Department of Highways, and the Agronomy Department of Virginia Polytechnic Institute and State University, we mulched a grass seeding along U.S. 460 in Mercer County. We applied 25 cubic yards of bark mulch to this 3/4-acre seeding, which was a 2:1 fill slope, 125 feet long and 260 feet wide.

To mulch the slope as efficiently as possible, we positioned MOBLOW at the top and laid out 9 sections (108 feet) of hose to the bottom. The high-pressure air stream easily cast the bark 30 feet to the toe of the long slope. We worked our way up the slope, uncoupling two or three lengths of hose at a time, and mulched 30 feet to each side as we went. The result was about a 60-foot swath from top to bottom of the slope. We repeated this procedure five times to cover the entire site.

To develop production data, we timed the operation. Operating times were recorded as setup time, blowing time, and downtime. Setup time included positioning MOBLOW and laying out the hoses. This took 26 minutes. Blowing time totaled 124 minutes; and downtime, caused by mechanical breakdowns and plugged hoses, consumed 58 minutes. Overall, the average rate of application was 7.2 cubic yards of mulch per hour. For the five swaths mulched the rate ranged from 5 to 20 cubic yards per hour.

Our second mulching trial was conducted on a

**Table 1.—Distribution of particle sizes of bark products and wood residues by percent of dry weight retained on screens**

| Material | Screen opening sizes (inches) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2 | 1 | 1/2 | 3/16 | 3/32 | 3/64 | 1/64 | <1/64 |
| *Raw bark residues* | | | | | | | | |
| mixed hardwoods | 6.1 | 3.6 | 8.1 | 24.4 | 19.1 | 12.2 | 14.3 | 12.2 |
| white cedar | 11.6 | 2.6 | 9.5 | 40.7 | 16.7 | 11.8 | 5.0 | 2.1 |
| *Fine hardwood residues* | | | | | | | | |
| fresh sawdust | — | — | 4.3 | 4.3 | 10.4 | 38.8 | 34.6 | 7.6 |
| dry planer shavings | no determination made | | | | | | | |
| *Shredded hardwood bark mulch* | | | | | | | | |
| processor A | — | — | 22.0 | 24.5 | 19.1 | 14.8 | 12.9 | 6.7 |
| processor B | 0.1 | 1.9 | 12.6 | 41.9 | 21.0 | 11.3 | 6.8 | 4.4 |
| processor C | — | 13.1 | 5.1 | 46.7 | 15.3 | 10.2 | 6.2 | 3.4 |
| processor D | — | .8 | 5.1 | 29.0 | 18.1 | 18.4 | 19.5 | 9.1 |
| *Pine bark products* | | | | | | | | |
| shredded grade | | | | | | | | |
| processor E | — | 0.7 | 19.6 | 55.8 | 8.0 | 3.7 | 5.9 | 6.3 |
| soil conditioner | | | | | | | | |
| processor E | — | — | .1 | 25.2 | 28.8 | 20.9 | 15.6 | 9.4 |
| processor F | — | — | — | .1 | 20.0 | 43.0 | 24.8 | 12.1 |
| mulch grade | | | | | | | | |
| processor F | — | — | 1.1 | 41.2 | 33.2 | 10.7 | 6.2 | 7.6 |
| mininugget grade | most particles 3/4 to 1-1/2 inches long | | | | | | | |
| nugget grade | most particles 1-1/2 to 2-1/2 inches long | | | | | | | |

shrub bed. In cooperation with the Department of Highways and a landscape contractor, we used MOBLOW to apply shredded bark to a 1,500-square-foot shrub bed that was located on Interstate 77 in Jackson County, West Virginia. The bed had been planted with 160 balled and burlapped shrubs.

We mulched the entire bed with a 4-inch layer of bark—about 17 cubic yards—in two operations. MOBLOW was first positioned on the road about 70 feet above the shrub bed; eight lengths of hose were needed to reach the bed. Next, MOBLOW was positioned along the shrub bed so only two lengths of hose were needed. In the first operation, 70 shrubs were mulched with 8 cubic yards of bark in 68 minutes; this included setup time, blowing time, and 15 minutes of downtime caused by plugged feeder and hoses. In the second, 90 shrubs were mulched in 32 minutes with 9 cubic yards of bark. Rates of application for the two operations were 7 and 17 cubic yards per hour. Overall, the rate averaged 10 cubic yards per hour.

We mulched the shrub bed with and without the deflector hood (figs. 3, 4). The hood controlled mulch placement and minimized the inpacting of bark particles against shrub stems. Mulch could be applied faster and blown farther without the deflector, but placement was less accurate.

*Estimating mulching costs.*—Many factors influence mulching costs. For this study we selected three major factors to develop a range of cost estimates for mulching seedings and shrub beds: (1) the cost of men and machines in mulching systems using MOBLOW; (2) the production rates of these systems; and (3) the amount of mulch applied per acre.

We planned two production systems, System I and System II. System I was designed for mulching large seedings on surface mines and along highways. Bark mulch is delivered in bulk quantities and stockpiled because of the distance of these jobs from supply yards. Thus a front-end loader and operator is required at the stockpile to load MOBLOW. System II, which was design-

**Figure 3.—Fresh sawdust mulch is applied with the deflector hood.**

**Figure 4.—Shredded hardwood bark mulch is applied without the deflector hood.**

ed for mulching shrub beds, does not include a loader and operator because loading services for System II jobs usually are provided at the supply yard. Equipment and manpower requirements for these systems are:

| System I *(Mulching seedings)* | System II *(Mulching shrub beds)* |
|---|---|
| MOBLOW | MOBLOW |
| + | + |
| End loader | Truck driver |
| + | + |
| Truck driver | Laborer |
| + | |
| Loader operator | |
| + | |
| Laborer | |

In estimating labor costs for Systems I and II, we used the wage schedule for 1975 highway construction contracts in West Virginia. Estimates of equipment operating costs, based on 1,400 hours of use per year, were developed for three MOBLOW units and three front-end loaders. The MOBLOW trucks were: (1) a used unit that cost $20,000; (2) a new unit with a standard-duty cab and chassis at $45,000; and (3) a new unit with a heavy-duty cab and chassis at $60,000. The front-end loaders were: (1) a used industrial tractor with a 3/4-yard bucket at $5,000; (2) a similar but new tractor that cost $12,000; and (3) a new, construction loader with a 4-yard bucket at $30,000.

The production rates for Systems I and II were developed from MOBLOW application rates and loading times for the two sizes of front-end loaders. We assumed that the application rates recorded in both trials represented low, average, and high performance, so we used

rates of 5, 8, and 18 cubic yards per hour. We used a loading time of 15 minutes for the big loader and 45 minutes for the small one.

The mulch rates selected for determining cost estimates were 30 and 50 cubic yards per acre for seedings, and 4 inches for shrub beds. These specifications follow the recommendations of Sarles and Emanuel *(1976)*.

## RESULTS AND DISCUSSION

*Materials testing.*—Unprocessed bark residues (mixed hardwoods and white cedar) failed in blowing trials because splintery particles longer than 2 inches repeatedly plugged the hose sections.

Processed shredded barks—both hardwood and pine—were blown successfully despite occasional plugging. We concluded that when particles longer than 2 inches are screened out, these bark products can be used with MOBLOW. Success in blowing the shredded materials depends largely on the operator's skill in metering the material into the airlock.

Processed pine barks—nuggets, mininuggets, mulch, and soil conditioners—were all blown successfully. Except for the soil conditioners, these chunky and platy barks handled and blew easily and didn't plug the hoses. Because of their weight and shape, bark nuggets were blown 45 feet; but finer soil-conditioner particles, which look easy to blow, compacted in the hoses and the injector tee when fed too fast. This could have been avoided by more careful control of the feed rate.

Planer shavings were the easiest of all materials to feed and blow; they could be metered into the airlock as fast as the operator could work, and the system was never overloaded (fig.5).

Fresh hardwood sawdust also seemed easy to blow, but it frequently plugged the injector tee and the hoses. However the plugging was not caused by the sawdust but by the pieces and chunks of wood that were mixed with it. We

**Figure 5.—MOBLOW handled dry, hardwood planer shavings exceptionally well; this material was blown as fast as it was fed into the system.**

**Table 2.—Acreage mulched per 8-hour day at 30 cubic yards of shredded bark mulch per acre by System I [a]**

| Application rate | Production rate (Loading times) | | Increased production due to faster loading |
|---|---|---|---|
| | 15 minutes | 45 minutes | |
| $yd^3$/hr | ----------acres---------- | | percent |
| 5 | 1.28 | 1.19 | 8.0 |
| 8 | 2.00 | 1.78 | 12.0 |
| 18 | 4.17 | 3.31 | 26.0 |

[a] For application of 50 $yd^3$ acre, multiply acreages by 0.6.

tried to solve the problem by placing an expanded metal grate with 1-1/2-inch openings over the inlet of the rotary airlock. While the grate screened out the large pieces and prevented plugging, it hindered the feed rate so much that its use proved impractical. Fresh or dry sawdust, if free of chunks of wood and debris, can be blown easily (fig. 3).

*Production rates.*—Rates of production for mulching seedings and shrub beds vary because of site conditions, the experience of the crew, equipment, mulching specifications, and loading time. We included these factors in developing our estimates of production rates for Systems I and II. For example, site conditions, crew experience, and equipment are accounted for in the range of application rates that we developed from the mulching trials.

In the System I operation, the rate of application has a large effect on daily production; it is more significant than loading time. Still, loading time is important because it works together with application rate to produce proportionately greater increases in daily production, particularly at the higher application rates. For example, a crew that applies mulch at a rate of 18 cubic yards per hour can increase production by 26 percent when it uses a faster operating loader; at 5 cubic yards an hour the crew can increase production only by 8 percent (table 2).

Since the application rate greatly affects daily production, it is important to note that the two factors—the experience of the crew and reliability of equiment—can be managed for improvement. Crews can be trained, and MOBLOW machines can be maintained in good operating condition. Attention to both can probably double low production rates.

**Table 3.—Production per 8-hour day at 4 inches of shredded bark mulch by System II [a]**

| Application rate | Daily production | |
|---|---|---|
| $yd^3/hr$ | $yd^3$ | $ft^2$ |
| 5 | 34 | 2,754 |
| 8 | 50 | 4,091 |
| 18 | 90 | 7,270 |

[a] Includes travel time of 1 hour for each trip to the supply yard.

Production rates for mulching shrub beds include a travel time of 1 hour for each trip to the supply yard to reload. By combining application rate and travel time, we found that MOBLOW and its crew could apply 34 to 90 cubic yards of shredded bark mulch per 8-hour day to a depth of 4 inches over shrub beds totaling 2,754 to 7,270 square feet (table 3).

*Cost estimates.*—We produced hourly operating costs for seven combinations of men and machines—four for System I and three for System II. For System I, hourly costs ranged from $36 an hour for used machines to $49 for new, heavy-duty machines. Depending on the cost of machinery, System II costs ranged from $25 to $30 per hour in West Virginia. These figures can be adjusted as costs change, or for other parts of the country (tables 4,5).

By combining hourly operating costs with production rates, we developed cost estimates for seedbed and shrub bed mulching (tables 4,5). It is obvious that mulching costs are affected more by the production rate than by hourly operating costs. So new or larger machines, or both, that perform at higher production rates than used or smaller machines, or both, can yield lower mulching costs than the "less expen-

**Table 4.—Estimated cost of System I operations in dollars per acre at 30 cubic yards of shredded bark mulch per acre[a]**

| System I machines | Operating cost | Production rate (acres/8 hour day) | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| | *dollars/hour* | *dollars/acre* | | | |
| Used MOBLOW and used 3/4-yard loader | 36 | 288 | 144 | 92 | — |
| New MOBLOW and new 3/4-yard loader | 40 | 320 | 160 | 107 | — |
| Used MOBLOW and new 4-yard loader | 43 | — | 172 | 115 | 86 |
| New heavy-duty MOBLOW and new 4-yard loader | 49 | — | 196 | 130 | 98 |

[a] For application of 50 $yd^3$/acre, multiply dollars per acre by 1.67.

**Table 5.—Estimated unit cost of System II operations at 4 inches of shredded bark mulch on shrub beds**

| System II machines | Operating cost | Production rate ($yd^3$ or 100 $ft^2$/8-hour day) | | |
|---|---|---|---|---|
| | | 30 | 60 | 90 |
| | *dollars/hour* | *dollars/unit* | | |
| Used MOBLOW | 25 | 6.67 | 3.33 | 2.22 |
| New MOBLOW | 28 | 7.47 | 3.74 | 2.49 |
| New heavy-duty MOBLOW | 30 | 8.00 | 4.00 | 2.66 |

sive" equipment. Regardless of the machines that are used, the production rate must exceed 2 acres per day for seedbed mulching, and 6,000 square feet per day for shrub-bed mulching, to keep unit costs competitive with other mulching techniques.

Contractors or landscapers can determine total mulching costs for bidding and other purposes by adding the price of bark mulch to our estimates of application costs (tables 4,5). They also may find our estimates useful for comparing the cost of mulching with bark to the cost of mulching with straw, hay, or wood-cellulose fiber.

## SUMMARY AND CONCLUSION

We found that bark blower trucks equipped according to MOBLOW specifications can effectively apply pine and hardwood bark products, screened sawdust, and wood shavings, but cannot handle unprocessed bark residues. Other equipment or methods are required for the application of unprocessed barks for mulch or bedding uses. On-the-job mulching trials in which shredded hardwood bark was used demonstrated MOBLOW's efficiency in mulching seedings on long, steep slopes, and highway plantings of large shrub beds.

We developed mulching production rates and costs for seven equipment/manpower systems employing MOBLOW. Unit costs for mulching jobs at average production rates seemed to fall within the range of costs for other mulching methods.

MOBLOW's performance on mulching jobs and its capability for doing other work makes it a versatile machine. It—or other mobile equipment with high-pressure blowers and rotary airlocks—can be used by seeding and mulching contractors, landscapers, employees of highway and park departments, and others who apply large volumes of mulch and bedding materials.

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# APPENDIX

## MOBILE BARK BLOWER SPECIFICATIONS

*Truck chassis and engine:*

Year and make: 1959 Reo.
Gross vehicle weight rating: 48,000 pounds
Tandem rear axle: 32M Eaton
Front axle: Timken FD901
Engine: Reo O.H. 200 "Gold Comet"
Fuel: Gasoline
Main transmission: Clark 290V
Auxiliary transmission: Spicer 6041
Tires: 9.00 x 20
Brakes: Air
P.T.O's: Two power take-offs from engine; one powers a hydraulic pump, the other a high-pressure rotary blower.

*Hydraulic system:*
Oil reservoir, hydraulic pump, two orbital motors, telescoping and single-action cylinders, and two-way control valves.

*Blower unit:* 6-71 GMC high-pressure rotary blower.

*Airlock unit:* 16 x 20 rotary feeder driven by hydraulic orbital motor.

*Blower hose:* Ten 12-foot lengths of 4-inch flexible metal hose fitted with quick couplers.

*Truck box:* Capacity 30 cubic yards; heavy-duty steel construction; moveable front bulkhead powered by telescoping hydraulic cylinder with cable return; top-mounted, hydraulically-operated rear door.


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