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Evaluation Report 300

Krone KR180 Baler

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

KRONE KR180 BALER

MANUFACTURER:
Machinenfabriken Bernard Krone GMBH
4441 Spelle
West Germany

DISTRIBUTOR:
Anthes Industries Inc.
Renn Division
12555 - 127 Avenue
Edmonton, Alberta
T5L 3E5

RETAIL PRICE:
$15,990.00 (May 1983, f.o.b. Edmonton, Alberta)

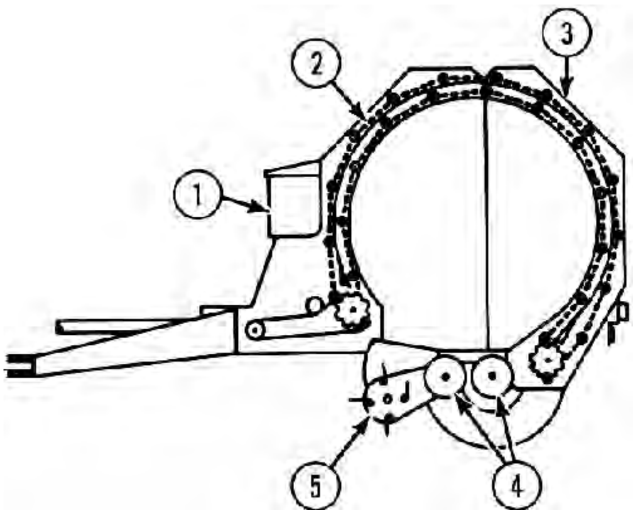

FIGURE 1. Krone KR180 Baler: (1) Twine Box, (2) Bale Forming Chain, (3) Rear Gate, (4) Platform Rollers, (5) Pickup.

SUMMARY AND CONCLUSIONS

Overall Performance: The performance of the Krone KR180 round baler was good in hay and most straw crops. Performance was reduced in very dry hay and straw crop conditions. Similar to most round balers, it was difficult to bale short, chopped up straw, similar to that passed through a rotary combine.

Capacity: The average capacity of the Krone KR180 varied from 2.0 ton/h (1.8 t/h) in wheat straw to 8.5 ton/h (7.7 t/h) in hay. Maximum instantaneous feedrates up to 19 ton/h (17 t/h) were measured in heavy, uniform greenfeed windrows. Feedrate was usually limited by pickup and feeding performance rather than by bale chamber capacity.

Bale Quality: Bale quality varied from very good in ideal crop conditions to only fair in very dry and unconditioned crops. In these conditions, bale quality was reduced due to poor bale shape and inadequate bale durability. Hay bales weighed from 1235 to 2060 lb (560 to 936 kg) and straw bales from 755 to 1125 lb (343 to 511 kg).

Weatherability: Bale moisture penetration and spoilage was minimal after 170 days of weathering.

Leaf Loss: Total leaf loss was comparable to that of other large round balers. In heavy windrows baled under ideal moisture conditions, bale chamber loss was 2% while pickup loss was less that 1%. In light, dry windrows, bale chamber loss was 6% and pickup loss was 3%.

Power Requirements: Peak power requirements were about 47 hp (35 kW) in hay and straw on level fields. However, a 65 hp (48 kW) tractor was needed to fully utilize baler capacity on soft or hilly fields.

Ease of Operation: It was very easy to start and form a bale with the Krone KR180. In greenfeed and tough hay a reduced ground speed was required when starting a bale. In light, dry crops, the bales often had to be wrapped and ejected before the bale was of adequate density. It was difficult to bale short straw due to backfeeding.

The twine wrapping mechanism was easy to operate and performed very well. A bale could be wrapped and discharged from the bale chamber in about one minute.

Feeding was positive in hay crops. Backfeeding occurred in straw and greenfeed. Removing the windguard improved feeding in these conditions.

The Krone KR180 was easy to maneuver and transport. Visibility to the rear was restricted.

Ease of Adjustment: Adjusting the Krone KR180 was simple. The forming chain, chain drives and the pickup were easy to adjust.

Lubrication was easy.

Operator Safety: The Krone KR180 was safe to operate if normal safety precautions were observed.

Operator's Manual: The operator's manual was not clearly written, but did contain useful information on operation, servicing, adjustments and safety procedures.

Mechanical Problems: A few mechanical problems occurred during the test, requiring repairs to the pickup and baler frame.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to prevent the rear gate from opening prematurely, allowing hay to drop out when baling in light, dry windrow conditions.
2. Modifications to prevent the base of the hitchjack from unscrewing due to vibrations.
3. Modifications to improve pickup floatation to prevent pickup damage on rough or stony ground.
4. Supplying a slow moving vehicle sign as standard equipment.
5. Modifications to eliminate premature failure of the frame bolts.

Senior Engineer: E. H. Wiens

Project Technologist: R A. Bergen

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The new KR-181 Baler for the 1983 season has been fitted with a latch on the rear opening gate. This prevents the rear gate from opening prematurely. Even a small pressure loss from hydraulic fluid does not affect the situation.
2. A new hitchjack has been fitted.
3. The 1984 production machine will have two boots underneath the pickup and the pickup will have spring-assisted floatation.
4. We have not yet supplied a "Slow Moving Vehicle" sign as standard equipment, but this recommendation will be noted.
5. Better production control has been implemented to eliminate premature failure of the frame bolts.

GENERAL DESCRIPTION

The Krone KR180 is a pull-type, power take-off driven baler with a cylindrical baling chamber and a floating drum pickup. The twine wrapping mechanism is automatic but requires manual starting.

Hay is fed directly into the baling chamber by the pickup. The baling chamber consists of two 9.7 in (247 mm) diameter rollers on the bottom directly behind the pickup, and a continuous slatted chain and outside track for the slatted chain.

FIGURE 1 shows the location of major components while detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Krone KR180 baler was operated in a variety of crops (TABLES 1 and 2) for 115 hours while producing 875 bales. It was evaluated for rate of work, quality of work, power consumption, ease of operation, ease of adjustment, operator safety and suitability of the operator's manual.

RESULTS AND DISCUSSION

RATE OF WORK

Throughput depended on windrow size and uniformity, crop condition, field surface, available tractor speeds and operator skill.

Average throughput for the Krone KR180 (TABLE 3) varied from 2.0 ton/h (1.8 t/h) in wheat straw to 8.5 ton/h (7.7 t/h) in alfalfa bromegrass mixture. The daily average throughputs reported in TABLE 3 are average workrates for daily field operation. They are representative of the actual workrates that may be expected in typical field operation. These values are based on the total operating time and the total baler throughput for each day of baling. The maximum average throughputs reported in TABLE 3 are representative of maximum average workrates obtained over short periods of operation under ideal operating conditions.

TABLE 1. Operating Conditions

Crop	Hours	Number of Bales	Field Area	
			ac	ha
Alfalfa	5	53	20	8
Alfalfa, Bromegrass	31	240	65	34
Alfalfa, Orchardgrass	20	167	55	22
Alfalfa, Bromegrass and Crested Wheatgrass	4	19	12	5
Bromegrass & Timothy	15	81	60	25
Green Feed	9	78	35	14
Barley Straw	15	124	35	14
Wheat Straw	16	113	60	25
Total	115	875	362	147

TABLE 2. Operation in Stony Fields

Field Condition	Hours	Field Area	
		ac	ha
Stone Free	53	157	64
Occasional Stones	38	111	45
Moderately Stony	24	94	38
Total	115	362	147

TABLE 3. Average Throughputs

Crop	Crop Yield		Average Speed		Daily Average Throughput		Maximum Average Throughput	
	ton/ac	t/ha	mph	km/h	ton/h	t/h	ton/h	t/h
Alfalfa	1.2-2.2	2.7-4.9	5.0	8.0	8.4	7.6	9.2	8.4
Alfalfa, Bromegrass	2.4	5.3	5.0	8.0	8.5	7.7	9.5	8.6
Alfalfa, Orchardgrass	2.3	5.0	4.5	7.3	5.7	5.2		
Alfalfa, Bromegrass and Crested Wheatgrass	1.7	3.7	5.0	8.0	6.7	6.1		
Bromegrass & Timothy	1.0	2.2	6.6	10.7	4.0	3.6	4.3	3.9
Green Feed	1.9	4.2	5.0	8.0	7.8	7.1	6.9	8.1
Barley Straw	1.5	3.3	5.0	8.0	4.3	3.9	6.1	5.5
Wheat Straw	0.6-0.8	1.4-1.7	6.6	10.7	3.4	3.1	6.2	5.6

In heavy, uniform greenfeed windrows, instantaneous throughputs up to 19 ton/h (17 t/h) were measured. These were peak values, representing maximum baler capacity, which cannot be achieved continuously.

In most crops, the feedrate was limited by pickup and feeding performance and not by bale chamber capacity. In light windrows the ground speed was normally limited to about 10 mph (16 km/h) due to bouncing on rough ground and poorer pickup performance at higher speed. Heavy windrows are desirable to fully utilize baler capacity.

Feeding was positive in most crops. In dry, short wheat and barley straw, feeding performance was reduced due to back feeding.

QUALITY OF WORK

Bale Quality: The Krone KR180 produced firm, durable bales with flat ends and uniform diameter in most crops (FIGURE 2). Bales were of very good quality when bated in well formed windrows at the optimum moisture content. However, in light, dry conditions, irrespective of crop and in unconditioned greenfeed, bale quality was reduced to fair as it was difficult to consistently produce bales of uniform diameter and adequate durability (FIGURE 3). Similar to most round balers, it was also difficult to consistently produce uniform, durable bales in dry, short, chopped up straw, similar to that combined with rotary combines. In short straw conditions, bale quality was greatly improved if the straw was baled when slightly tough.

Due to the low density bale core, bales were slightly more difficult to handle with some bale handlers than bales with a high density core.

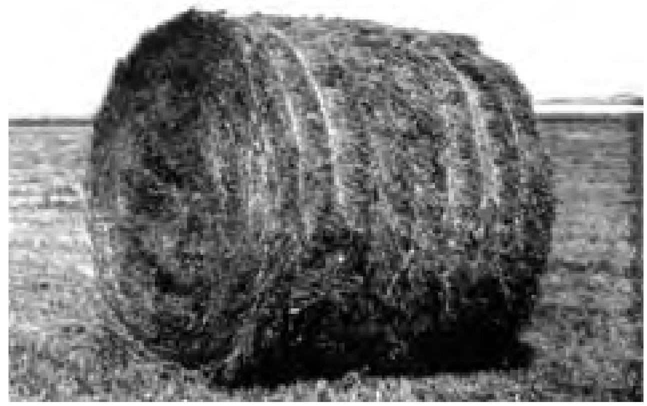

FIGURE 2. Typical Hay Bale.

FIGURE 3. Inadequate Bale Density in Light Dry Material.

A typical hay or straw bale average 59 in (1.5 m) in length and 71 in (1.8 m) in diameter. Bales usually settled to about 88% of their original height after 100 days. Although the bales had a low density core, the bales settled only slightly more than high density core bales. Average hay bales weighed from 1235 to 2060 lb (560 to 936 kg) with average densities ranging from 8.6 to 14.4 lb/ft³ (143 to 240 kg/m³). Average straw bales weighed from 755 to 1125 lb (343 to 511 kg) with average densities ranging from 5.1 to 7.5 lb/ft³ (85 to 125 kg/m³).

Bale Weathering: A common practice in the prairie provinces is to store round bales outside. Bales were closely stacked in rows, situated in a level area, with one side exposed to the prevailing winds. Bales were subjected to about 4.5 in (115 mm) of rain and above average wind conditions over a period of about 170 days. FIGURE 4 shows the condition of a typical Krone KR180 hay bale (alfalfa and bromegrass mixture) after 170 days of weathering. The condition of the weathered bales was good. Moisture had penetrated to a maximum of 5 in (127 mm) on the windward side in the area where another bale was touching. Spoilage occurred to a depth of about 1.5 in (40 mm) in the ground contact area and where other bales touched the sides.

Leaf Loss: Leaf loss was comparable to that of other large round balers. The Krone KR180 was tested in a heavy crop of mixed alfalfa and bromegrass which had been cut with a 14 ft (4.3 m) wide mower-conditioner. Average crop yield was about 2.4 ton/ac (5.3 t/ha). Total leaf loss ranged from 9% when baled at 9% hay moisture content to about 2% when baled at 22% hay moisture content. At 9% hay moisture content, pickup loss was about 3% and bale chamber loss about 6%, whereas at 22% hay moisture content, pickup loss was less than 1% and bale chamber loss about 1%.

FIGURE 5 shows the importance of baling at higher moisture contents. This figure represents an accumulation of data for several round balers showing the total measured leaf loss over a range of hay moisture contents, in fields of mixed alfalfa, crested wheatgrass and bromegrass. Although the Krone KR180 was tested in a different crop, its performance was within the range presented in the figure with the exception of slightly lower losses at higher moisture contents.

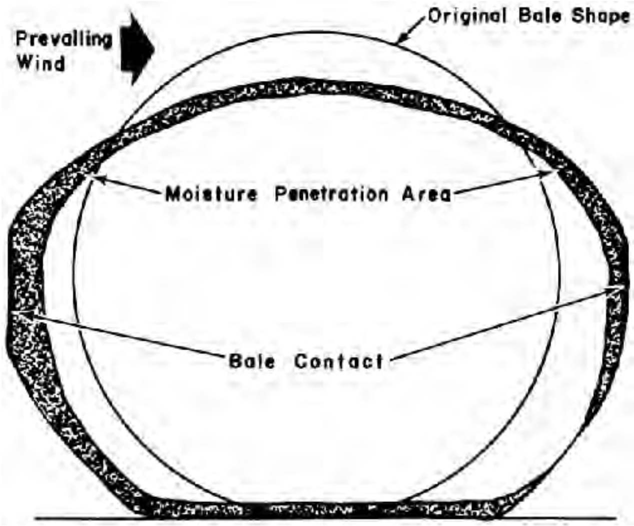

FIGURE 4. A Typical Hay Bale After 170 Days of Weathering.

FIGURE 5 represents nearly ideal baling conditions with relatively heavy windrows, which had been conditioned to enhance drying of the hay stems. Much higher leaf loss can be expected in light, unconditioned windrows. While feedrate did not appreciably affect losses in the ideal conditions shown in FIGURE 5, loss tests in light unconditioned windrows have shown that round baler losses can be reduced by keeping the feedrate as high as possible to minimize time in the baling chamber. Bale chamber losses in light crops can also be reduced by running the tractor at a lower power take-off speed to reduce the number of turns needed to form a bale.

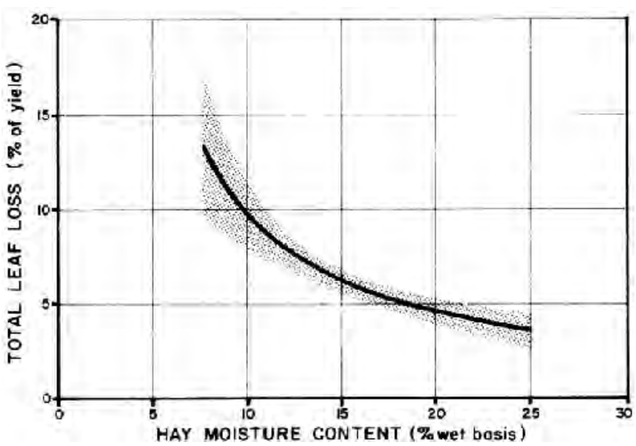

FIGURE 5. Leaf Loss in Mixed Alfalfa, Crested Wheatgrass and Bromegrass.

POWER CONSUMPTION

Power Requirements: FIGURE 6 shows the power take-off and drawbar input for the Krone KR180. The power input is plotted against bale weight to show the power requirements while a bale is formed. Power take-off input varied from 2.7 hp (2 kW) at no load to a maximum of 42 hp (31 kW). Drawbar requirements at 6.8 mph (11 km/h) on flat firm fields were about 5.5 hp (4 kW). Although maximum power requirements did not exceed 48 hp (36 kW), additional power was needed to suit field conditions. In soft, hilly fields a 65 hp (49 kW) tractor would be needed to fully utilize baler capacity.

Specific Capacity: Specific capacity is a measure of how efficiently a machine performs a task. A high specific capacity indicates efficient energy use while low specific capacity indicates inefficient operation. The specific capacity of the Krone KR180 was about 0.88 ton/hp•h (1.1 t/kW•h) in hay and 0.66 ton/hp•h (0.83 t/kW•h) in barley straw. This compares to an average specific capacity of 0.6 to 1.2 ton/hp•h (0.7 to 1.4 t/kW•h) for small square balers in alfalfa. These values represent average field conditions and not peak outputs.

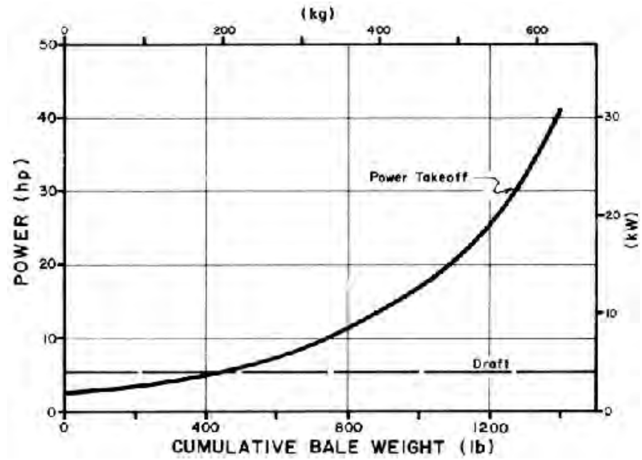

FIGURE 6. Power Consumption During Bale Formation in Alfalfa Bromegrass.

EASE OF OPERATION

Forming a Bale: It was easy to form a neat, durable bale in most crops. Feeding hay across the entire width of the bale chamber during bale core formation was not critical as the hay tumbled within the bale chamber, distributing itself quite evenly across the chamber. Alternate side to side feeding was required during the later stages of bale formation to produce bales of uniform diameter. FIGURE 7 shows stages of bale formation in the Krone KR180.

FIGURE 7. Stages of Bale Formation: (Left) Starting Bale, (Centre) Partially Completed Bale, (Right) Completed Bale.

In very heavy greenfeed and tough hay windrows, plugging would occasionally occur at the throat of the chamber, if the ground speed was too high when starting a bale. The plugging resulted from the hay not beginning to tumble. If the hay wad was tough, it was usually most convenient to discharge the wad and start again. Starting the bale at a reduced ground speed usually eliminated this problem.

In light, dry crop conditions, the bales would often have to be wrapped and discharged prematurely. When the bale was nearing completion the rear gate would open slightly, allowing the windrow to drop back on the ground behind the baler (FIGURE 8) before the hydraulic pressure gauge indicated the bale was ready for wrapping. The bale would then have to be wrapped and discharged as the rolling bale would not take up any more hay. In these conditions, bale quality was only fair due to the inability to produce bales of adequate density. Also, since visibility to the rear was limited, the operator had difficulty in determining when hay would begin dropping out the back. It was inconvenient to rebale the portions of windrow left behind. The operator’s manual indicated that the gate was to open slightly and drop the windrow back on the ground when the bale chamber was overfilled. However, the gate began to open before the hydraulic system relief pressure was reached. Increasing the relief pressure only improved the problem slightly. It is recommended that modifications be considered to prevent the rear gate from opening prematurely, allowing hay to drop out when baling in light, dry windrow conditions.

In dry straw, backfeeding presented several problems. Straw piled up on the windguard, jamming between the back panel of the twine box and the front bale chamber housing (FIGURE 9). Removing the pickup windguard allowed bailing in these conditions. Also, at the beginning of the twine process, when the wrapping process begins on the right side, straw would continue to backfeed on the left side, piling up on the ground in front of the pickup. The result was a poor, lopsided bale. Baling straw when it was slightly tough, greatly reduced backfeeding and improved bale quality.

Wrapping the Twine: A hydraulic pressure gauge at the front of the baler showed when the bale was complete and ready for twine wrapping. The Krone KR180 was equipped with an automatic twine wrapping mechanism, which was manually started. To start wrapping, the starting rope was pulled about three times to feed twine onto the windrow. Once the twine had been caught by the rolling bale, the tractor and baler forward speed was stopped and the wrapping process continued automatically by means of a twine carrier driven by the incoming twine. The twine carrier picked up the twine at the center of the bale chamber and carried it to the right side, back across the bale face to the left side before returning to the centre. There the stationary knife cut the twine, stopping the process. The twine cutter performed very well.

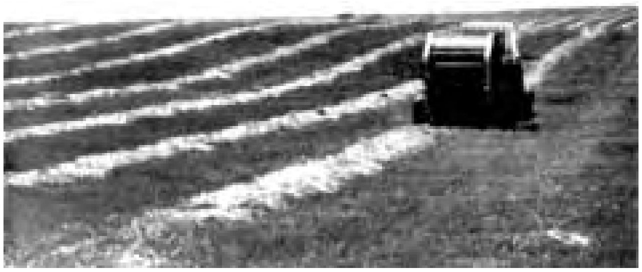

FIGURE 8. Windrow Dropping Out Behind the Baler in Light, Dry Crop Conditions.

FIGURE 9. Dry Straw Piled On the Pickup Windguard Due to Backfeeding.

The twine wrapping mechanism had four wrap spacing settings, which was adequate for all conditions encountered during the test. The twine wrapping mechanism performed very well with only a few minor problems. Sufficient twine tension was required to prevent the twine from slipping off the twine feed rollers during wrapping. Occasionally, when starting the wrapping process the twine would be fed in front of the pickup windguard due to wind or a wad of hay being backfed on top of the windguard. The twine carrier then would not pick up the twine, allowing the twine to wrap in one spot on the bale. If this happened the twine had to be cut and the wrapping process started again. In conditions where backfeeding was a problem, it was best to remove the pickup windguard.

Twine consumption was about 388 ft/ton (130 m/t) in hay at the maximum wrap setting. This compares to a twine consumption of about 670 ft/ton (225 m/t) for small square balers. The required wrap setting depended on the type of crop, condition of crop, type of twine and desired bale durability.

Discharging a Bale: Once the twine was cut, the power take-off was shut off and the tractor and baler were backed up about 20 ft (6 m). The gate was hydraulically opened and the power take-off was re-engaged, with the tractor at idle, to eject the bale. The forming chain was automatically disengaged when the gate opened. The tractor and baler were then moved ahead about 15 ft (4.5 m) allowing the gate to be closed. When the gate was fully closed the forming chain engaged automatically. The gate was closed to a preset hydraulic pressure by continuing to actuate the tractor hydraulics until relief pressure was reached. About one minute was needed to wrap and discharge a bale.

Transporting: The Krone KR180 was easy to maneuver and transport. Ground clearance was adequate and there was ample hitch clearance for turning sharp corners. Care had to be taken when backing up or transporting on roadways due to obstructed visibility to the rear. The baler could be easily towed behind a tractor or a suitably sized truck.

Hitching: The Krone KR180 was easy to hitch to a tractor. The hitch height was adjustable by adding or removing spacers between the hitch and the baler frame. The hitchjack was convenient for raising and lowering the hitch tongue. With the hitch jack in its stored position, the base of the jack would unthread due to vibration during both transport and field operation. It is recommended that modifications be considered to prevent the base of the hitch jack from unthreading.

Feeding: Feeding was positive in most crops with only infrequent plugging. In most straw conditions it was necessary to remove the pickup windguard to prevent straw from piling up on the windguard due to backfeeding. In very short straw, this resulted in uneven feeding and excessive pickup losses. In fluffy straw and greenfeed windrows, feeding was improved with the windguard removed. Reduced ground speed was required when starting a bale in very heavy windrows to prevent plugging.

Twine Threading: Twine threading was quite easy. A twine threading diagram was conveniently located on the front of the twine box. The operator's manual also contained a twine threading diagram complete with twine threading procedures.

EASE OF ADJUSTMENT

Forming Chain: The slatted forming chain rotated on a fixed track around the outer perimeter of the bale chamber. Chain tension could be easily adjusted with a wrench. The operator's manual recommended the chain tension be checked with a bale in the bale chamber. The procedure given in the operator's manual was not clear. Only occasional adjustment was required.

Drives: The tension adjustment on the drive chains was easily made with adjustable idlers. The power take-off slip clutch was not adjustable and no adjustment was required throughout the test.

Pickup: The pickup was raised and lowered by a hydraulic cylinder. An adjustable cylinder stop pin was provided to maintain the pickup at a predetermined height. The pickup adjustment range was sufficient for all conditions encountered during the test. The pickup height was fixed, once the desired height was set, with no floatation mechanism. Since the pickup was often set to within 4 in (100 mm) of the ground to pick the windrow clean, it was quite susceptible to damage on rough or stony ground. It is recommended that the manufacturer consider modifications to improve pickup floatation.

The pickup windguard could be easily removed by hand. The pickup windguard was not adjustable. The pickup drive chain adjustment required the pickup be moved forward or back to obtain the correct tension.

Servicing: The Krone KR180 had four drive chains, seven grease fittings and one gearbox. The operator's manual recommended lubrication of two grease fittings every 8 hours, three grease fittings and lubricating the drive chains with grease every 10 hours, two grease fittings, the dog clutch and oiling the forming chain every 20 hours. Also recommended was that the gearbox oil be changed after the first 500 bales and every subsequent 2000 bales. About 15 minutes were needed to fully service the Krone KR180.

OPERATOR SAFETY

The operator is cautioned that a round baler is potentially very dangerous. The operator must disengage the power takeoff and stop the tractor engine to clear blockages or to make adjustments.

Many serious and fatal accidents have occurred with round balers. Most of these are caused by operators dismounting from the tractor while leaving the baler running. The manufacturer can only go to certain limits in providing shielding and safety devices and must rely of the operator's common sense in following established safety procedures.

The Krone KR180 was safe to operate and service as long as common sense was used and the manufacturer's safety recommendations were followed. Rotating parts were well shielded. The pickup and feeding area were well shielded to discourage operators from attempting to clear blockages with the baler in operation.

The Krone KR180 had rear gate cylinder stops to permit safe servicing with the rear gate open.

The Krone KR180 was not equipped with a slow moving vehicle sign or mounting bracket. It is recommended that a slow moving vehicle sign be supplied as standard equipment.

OPERATOR'S MANUAL

The operator's manual was not clearly written. However, it contained useful information on operation, servicing, adjustments, and safety procedures. Several illustrations were incorrectly labelled. A complete parts list was included although it was written in German.

MECHANICAL PROBLEMS

TABLE 4 outlines the mechanical history of the Krone KR180 during 115 hours of operation while baling 875 bales. The intent of the test was functional evaluation. The following failures represent those, which occurred during functional testing. An extended durability evaluation was not conducted.

TABLE 4. Mechanical History

Item	Operating Hours	Equivalent Bales
Drives		
-The pickup drive chain came off and required adjustment at	19	190
-All drive chains required adjustment at	102	784
Forming Chain		
-The forming chain required adjustment at	33, 77, 84	266, 592, 648
Twine Wrapping Mechanism		
-The twine guide by the feed rollers required adjustment at	1	6
-The twine box tension adjustment bolts required paint be removed to provide adequate adjustment at	73	554
Hydraulics		
-The "O" ring on the pilot relief valve ruptured and was replaced at	33	266
-A 6 mm flat washer was added to the rear gate relief valve to increase relief pressure at	86	656
Pickup		
-The pickup was damaged, requiring repair of several pickup hoops, tooth bars and pickup teeth at	26	220
Frame		
-Two bolts securing the front housing and the support brackets broke and a third was cracked, requiring replacement at	115	875

DISCUSSION OF MECHANICAL PROBLEMS

Pickup: Poor pickup floatation allowed several pickup hoops, tooth bars and pickup teeth to be bent on rough ground (FIGURE 10). Care had to be taken to miss larger stones to prevent serious damage to the pickup. The pickup was not equipped with a floatation mechanism. It has already been recommended that the manufacturer consider modifications to improve pickup floatation.

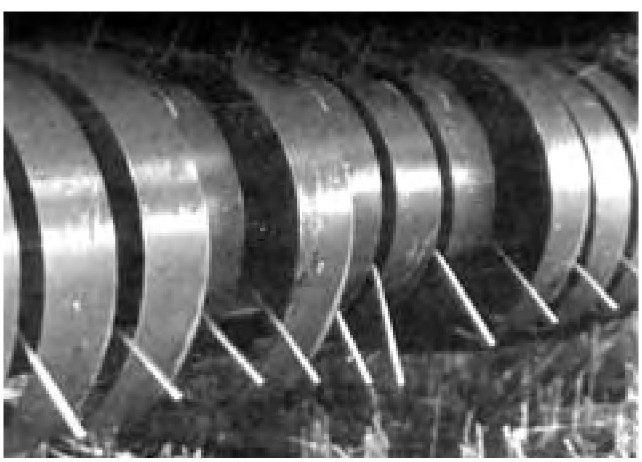

FIGURE 10. Damaged Pickup.

Frame: A frame bolt securing the front housing and the roller support brackets broke on each side and a third bolt was cracked. The failures were due to high tension loads and fatigue. FIGURE 11 illustrates the broken bolt and spreading between the front housing and the roller support bracket on one side. The bolt heads were welded to the frame making it difficult to replace the bolts. It is recommended the manufacturer consider modifications to eliminate premature failure of the frame bolts.

FIGURE 11. Frame Failure: (Upper) Broken Bolt, (Lower) Spreading Between the Front Housing and the Roller Support Bracket.

APPENDIX I
SPECIFICATIONS

MAKE:	Krone
MODEL:	KR180
SERIAL NUMBER:	1377
MANUFACTURER:	Machinenfabriken Bernard Krone GmbH 4441 Spelle West Germany
OVERALL DIMENSIONS:	
-- width	58 in (1460 mm)
-- height	96 in (2445 mm)
-- length	147 in (3720 mm)
-- ground clearance	10 in (260 mm)
TIRES:	
-- size	2, 11.5/80-15, 8-ply
WEIGHT: (field position and two balls of twine)	
-- left wheel	1782 lb (808 kg)
-- right wheel	1793 lb (813 kg)
-- hitch point	507 lb (230 kg)
Total	4082 lb (1851 kg)
BALE CHAMBER:	
-- width	59 in (1500 mm)
-- maximum diameter (fixed)	71 in (1800 mm)
-- tension method	hydraulic
-- bale peripheral speed (at 540 rpm)	3.0 mph (4.9 km/h)
BALE CHAMBER PLATFORM:	
-- number of rollers	2
-- roller length	59 in (1498 mm)
-- roller diameter	9.72 m (247 mm)
-- roller spacing	10.83 in (275 mm)
-- roller surface speed (at 540 rpm)	4.6 ft/s (1.4 m/s)
-- roller surface	tubular steel with 6 steel slats
-- roller speed (drive)	106 rpm
FORMING SECTIONS:	
-- type	continuous slatted chain complete with roller bearings on a fixed track
-- slat spacing (centre to centre)	12 in (305 mm)
-- chain speed (at 540 rpm)	4.4 ft/s (1.35 m/s)
-- chain size	2 in (50 mm) double pitch
--- slat size	1.38 in (35 mm) diameter
BALE SIZE INDICATOR:	hydraulic pressure gauge
PICKUP:	
- type	cam actuated drum with spring teeth
-- height adjustment	hydraulic with stop pin, 8 positions
-- width	58.9 in (1495 mm)
-- diameter	10.25 in (260 mm)
-- number of tooth bars	4
-- tooth spacing	2.75 in (70 mm)
-- speed (at 540 rpm)	108 rpm
-- tooth tip speed	5.3 mph (8.6 km/h)
TWINE SYSTEM:	
-- capacity	6 balls
-- recommended twine size	590 - 885 ft/lb (400 - 600 m/kg)
-- twine feed	manual start, automatic feed
-- twine cutter	stationary knife
DRIVES:	
-- number of chain drives	4
-- number of gear drives	1
-- number of universal joints	2
SAFETY DEVICES:	
-- non-adjustable power take-off	slip clutch
-- non-adjustable roller, pickup drive	slip clutch
-- hydraulic system	relief valve
-- rear gate	cylinder stops
-- slatted chain drive	dog clutch
SERVICING:	
-- grease fittings	2, every 8 hours 3, every 10 hours 2, every 20 hours
-- chains (drive)	4, grease every 10 hours
-- slatted chain	1, oil every 20 hours
-- slatted chain dog clutch	1, grease every 20 hours
-- gearbox	1, change oil every 2000 hours

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

Excellent	Fair
Very good	Poor
Good	Unsatisfactory

APPENDIX III
CONVERSION TABLE

acres (ac) x 0.40	= hectares (ha)
miles/hour (mph) x 1.61	= kilometres/hour (km/h)
tons (ton) x 0.91	= tonnes (t)
tons/hour (ton/h) x 0.91	= tonnes/hour (t/h)
tons/acre (ton/ac) x 2.24	= tonnes/hectare (t/ha)
inches (in) x 25.4	= millimetres (mm)
feet (ft) x 0.305	= metres (m)
horsepower (hp) x 0.75	= kilowatts (kW)
pounds (lb) x 0.45	= kilograms (kg)
pounds/cubic foot (lb/ft^3) x 16.1	= kilograms/cubic meter (kg/m^3)
tons/horsepower hour (ton/hp•h) x 1.22	= tonnes/kilowatt hour (t/kW•h)

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