STOCKPILE COAL HANDLING

CONTENTS

INTRODUCTION

Efficient methods have been developed for handling and storing coal with mobile equipment. Generally, a power plant or other industrial facility which uses coal, meets its daily requirements with incoming coal shipments and will maintain an emergency stockpile or deadpile. The deadpile is designed to meet the burn requirements during any interruption of coal shipments. Interruptions may include inclement weather, carrier strikes, scheduling problems, etc.

The deadpile will contain approximately a 90 day supply of coal and is constructed by thoroughly compacting lifts, or layers, of coal approximately 15 cm (6 in) thick. Thorough compaction of the entire stockpile, including the sides, eliminates air spaces, reducing the possibility of spontaneous combustion.

Reclaiming the deadpiled coal is critical when incoming shipments are not able to satisfy the burn requirements. Four basic types of mobile equipment are available for stockpiling and reclaiming coal — track-type tractors, wheel dozers, wheel loaders, and wheel tractor-scrapers. Each type has its own specific advantages. The equipment selected must be able to meet the maximum hourly burn rate.

MACHINE SELECTION

Track-Type Tractors

Track-type tractors continue to be the most widely used machines for coal handling operations. Equipped with a U-shaped coal dozer, they are suitable for meeting high production requirements over dozing distances of less than 152 m (500 ft). Their tractive capabilities and gradeability permit them to operate on the sides of the stockpile and surge pile which often prove inaccessible to other types of equipment. They can also remove snow and frost penetrated coal from the stockpile surface so that rubber-tired equipment can work efficiently.

Wheel Dozers

These machines, with their long wheel base, low center of gravity, and articulated design, offer good stability and maneuverability. They have the ability to travel at a higher speed than the track-type tractor, moving easily from one area of operation to another, and provide greater compactive effort with fewer passes. They are capable of performing some utility functions. However, their coefficient of traction is less than that of track-type tractors. The most efficient dozing distance for the wheel dozers is usually less than 152 m (500 ft).

Coal scoops are also available for wheel dozers and may improve production under certain operating conditions.

Wheel Loaders

As dozing and hauling distances increase, wheel loaders are able to effectively move coal in load-and-carry operations. Since coal is a relatively light material, the loaders should be equipped with larger buckets sized for coal density. Versatility and mobility allow them to perform a variety of tasks, both on and off the stockpile. They can load trucks or railcars, dig out bottom ash and boiler slag from the ash storage areas, and move railcars within the vicinity of the power plant. Generally wheel loaders are more efficient than track or wheel dozers at distances of 122 m (400 ft) or more.

Coal Bowl Wheel Tractor-Scrapers

Coal Bowl Wheel Tractor-Scrapers are typically used for building and maintaining coal stockpiles and hauling coal to the supply system at coal power plants. The self-loading capability, large capacity, coal pile compaction, and high speed of Coal Bowl Wheel Tractor-Scrapers make them the tool of choice for moving coal both short and long distances. Coal Bowl Wheel Tractor-Scrapers are available in the 637G and 657G tandem engine models. Please reference section 8 of this handbook for more information on Coal Bowl Wheel Tractor-Scrapers.

HOW TO EQUIP

Counterweighting

While larger blades or buckets allow for greater production, counterweighting is often necessary to improve the machine's balance and handling capability. For track-type tractors, a rear counterweight is recommended. Wheel machines use various methods to add weight. For example, scoop dozers use front counterweights, and wheel machines often use tire ballast. Below is a weight comparison of the Caterpillar standard U-blade to the Coal Dozer, along with the recommended counterweight for D11T, D10T, D9T, D8T, and 834H.

COAL STOCKPILE BLADE WEIGHT COMPARISON/ COUNTERWEIGHTING

Model	U-Blade kg	U-Blade lb	Coal Dozer/ Scoop kg	Coal Dozer/ Scoop lb	Counterweight kg	Counterweight lb
D11T	11 608	**25,590**	11 340	**25,000**	4989	**11,000**
D10T	6188	**13,643**	6440	**14,200**	2928	**6456**
D9T	4179	**9214**	4490	**9900**	3142	**6926**
D8T	2825	**6228**	3200	**7050**	2749	**6060**
834H	2994	**6600**	3630	**8000**	75% $CaCl_2$ in all tires —	
*834H with Scoop			8700	**19,180**	5360	**11,816**

Weights include blade or scoop only. The change in machine weight is determined by adding or subtracting the difference between the two blades. Counterweight or ballast may also need to be considered.

Track Shoe Width

Track shoes are an important consideration since shoe width determines tractive capability and compaction. Depending on the coal being stockpiled, the utility company will often have a strong preference concerning track shoe width. Basically, utilities stockpiling low rank or sub-bituminous rank lignite coal usually prefer the standard shoe width for maximum compactive effort to reduce the possibility of spontaneous combustion.

Utilities burning medium or high rank bituminous coals are not as concerned with spontaneous combustion and sometimes prefer a wider shoe that allows increased tractive capability on loose or less densely compacted coal stockpiles.

Tires

Many utility companies have established a tire preference for wheel machines. Normally a radial tire allows for the maximum tire print in the stockpile surface providing the best traction.

Tire pressure may be of equal importance to tire selection. Tests with hydro-inflated (liquid ballasting) tires indicate that inflation pressure of approximately 275 kPa (40 psi) improves machine performance over higher inflation pressure. Lower than 275 kPa (40 psi) is not recommended for hydro-inflated tires. (For more hydro-inflation information see the Tire section.)

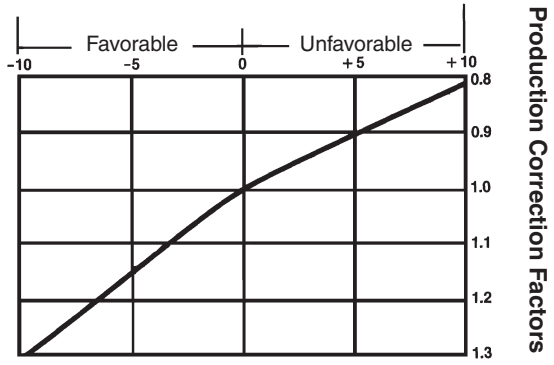
Other

The 834H's performance may be improved in the varying underfoot conditions of a coal stockpile with the use of a Detroit NoSPIN differential. This differential provides added tractive capability on all coal piles, particularly loose coal.

PRODUCTION FACTORS

1. *The effect of grade* — dozer production will increase 3% for each 1% of favorable grade and decrease 2% for each 1% of adverse grade up to grades of 10%. The graph below exemplifies this point.

Effect of Grade on Production



As a rule of thumb, track-type tractors can negotiate grades of about 60% in *loose* coal. Wheel dozers can negotiate grades up to 25% on fairly well *compacted* coal.

2. *Slot dozing*, which consists of dozing repeatedly in the same tracks, will increase production. The deeper the slot, the greater the increase in production. Obviously this will disrupt the surface of the pile; however it does provide maximum production.

Slot Condition	Slot Depth	Increase in Production
Slight	60 cm ~ **2 ft**	10%
Consistent	60 cm-1.5 m ~ **2-5 ft**	25%
Very Consistent	Over 1.5 m ~ **Over 5 ft**	30% +

3. *Relative traction* — machines will provide greater tractive effort as the compaction beneath them increases.

Condition	Machine	Coefficient of Traction
Well Compacted Coal	Track-type	*0.75-0.80
	Wheel	0.40-0.50
Loose Coal	Track-type	*0.60
	Wheel	0.30-0.40

*D11T, D10T, D9T and D8T will often achieve a higher coefficient of traction due to their suspended undercarriage.

4. *Rolling Resistance* of rubber tired equipment will decrease as the compaction of the coal beneath the machines increases. Here are total rolling resistances on various surfaces.

	kg/Metric Ton	lb/U.S. Ton
• Main travel area from loading area to stockpile traveled and maintained.	29	**65**
• Travel over the compacted deadpile.	36	**80**
• Travel over thin lifts of uncompacted coal on the deadpile.	54	**120**
• Travel on loose piles under stacking conveyor or on a windrow.	90-136	**200-300**

5. *The degree of compaction required* — for medium and high rank bituminous coal, track-type tractors will normally provide ample compaction to prevent fires. For low rank coals, such as sub-bituminous and lignite, rubber tired machines, pneumatic compactors or sealing may be required to prevent fires. The following table illustrates the compaction that is possible if the coal is spread in thin lifts and the machine makes a sufficient number of passes over the entire lift surface.

Machine	kg/m³	lb/ft³	lb/yd³
Track-Type Tractors	960-1160	**60-72**	**1620-1950**
Wheel Dozers	1040-1200	**65-75**	**1750-2030**
Wheel Loaders	1040-1250	**65-78**	**1750-2110**
Wheel Tractor-Scrapers	1100-1280	**68-80**	**1840-2160**

ESTIMATING HOURLY PRODUCTION

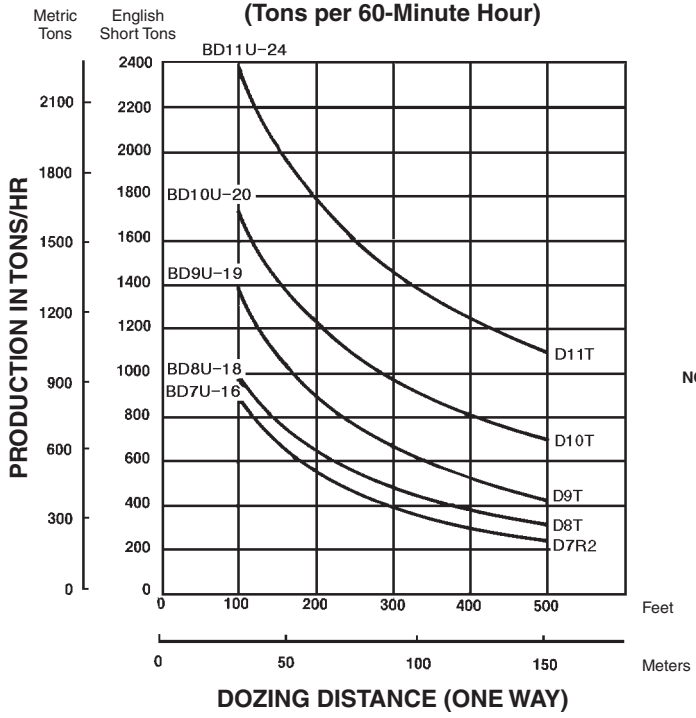
The following graphs may be used for estimating the hourly production of machines handling mixed bituminous coal. The graphs are based on 100% machine efficiency under normal job conditions and average operator; they do not take into account adverse grades, downtime, wait time, poor traction, etc. These production estimates should be evaluated in light of individual job conditions and efficiency. Moreover, a job efficiency correction factor should be applied to the production estimate shown when using these graphs.

To estimate travel times for a specific machine refer to the performance graphs or charts in the appropriate model section of this book.

NOTE: Capacities and production curves on the next pages are based on bituminous coal with a density of 890 kg/m³ or 1500 lb/yd³ or 55 lb/ft³. For sub-bituminous coal with a density of 800 kg/m³ or 1350 lb/yd³ or 50 lb/ft³ multiply tonnage figure by 0.90. For lignite with an average density of 710 kg/m³ or 1200 lb/yd³ or 45 lb/ft³ multiply tonnage figure by 0.80.

Track-Type Tractors Estimated Production with U-Blade (Coal Dozer)

Factors:
- **Mixed Bituminous Coal**
- **Storage and Reclamation**
- **0% Grade**
- **0.80 Coefficient of Traction**



NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

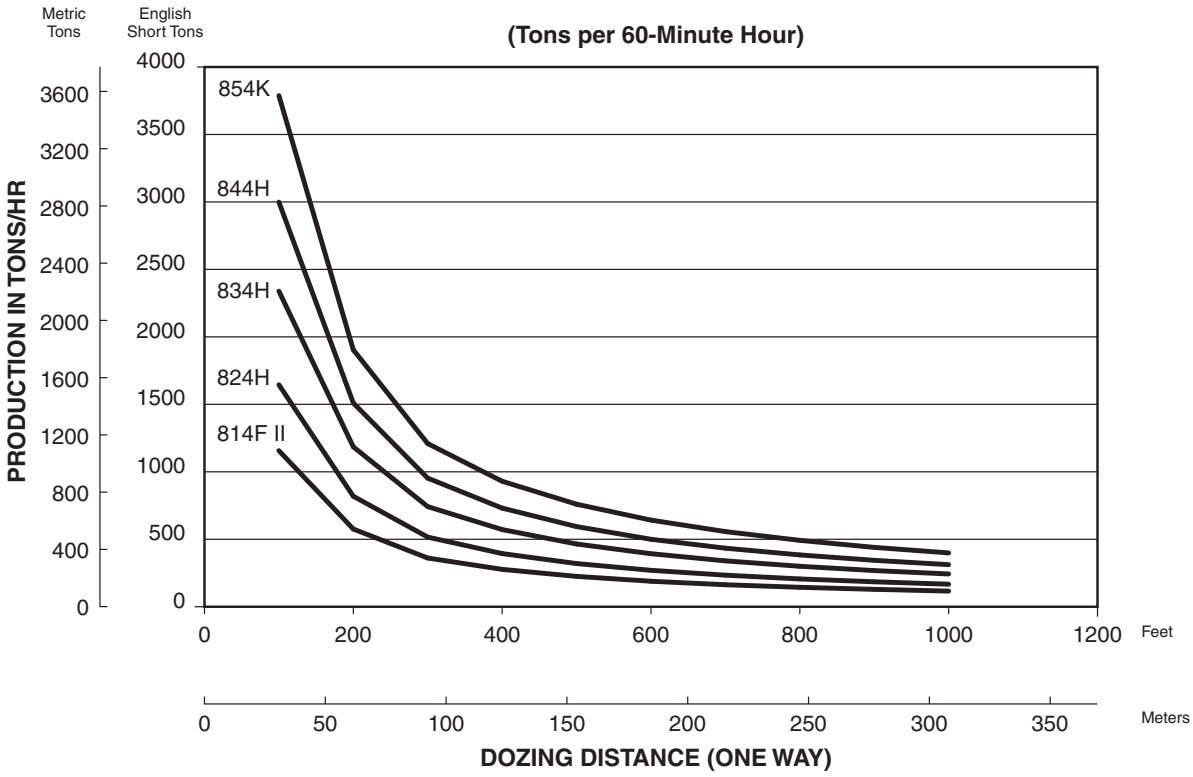
	U-Blade			Blade Capacities			
Tractor	**Model**	**m**	**ft**	**Metric tons**	**U.S. tons**	**m^3**	**yd^3**
D11T	BD11U-24	7.32	**24'**	66.7	**73.5**	74.9	**98.0**
D10T	BD10U-20	6.10	**20'**	40.85	**45.0**	45.9	**60.0**
D9T	BD9U-19	5.79	**19'**	32.6	**35.9**	37.0	**48.0**
D8T	BD8U-18	5.49	**18'**	19.0	**21.0**	21.4	**28.0**
D7R2	BD7U-16	4.88	**16'**	14.28	**15.75**	16.05	**21.0**
D6R	BD6U	4.27	**14'**	8.84	**9.75**	9.9	**13.0**

Refer to Track-Type Tractor/Bulldozer section for additional special attachment specifications.

Wheel Dozers Estimated Production with U-Blade (Coal Dozer)

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

Factors:
- **Mixed Bituminous Coal**
- **Storage and Reclamation**
- **0% Grade**
- **0.80 Coefficient of Traction**



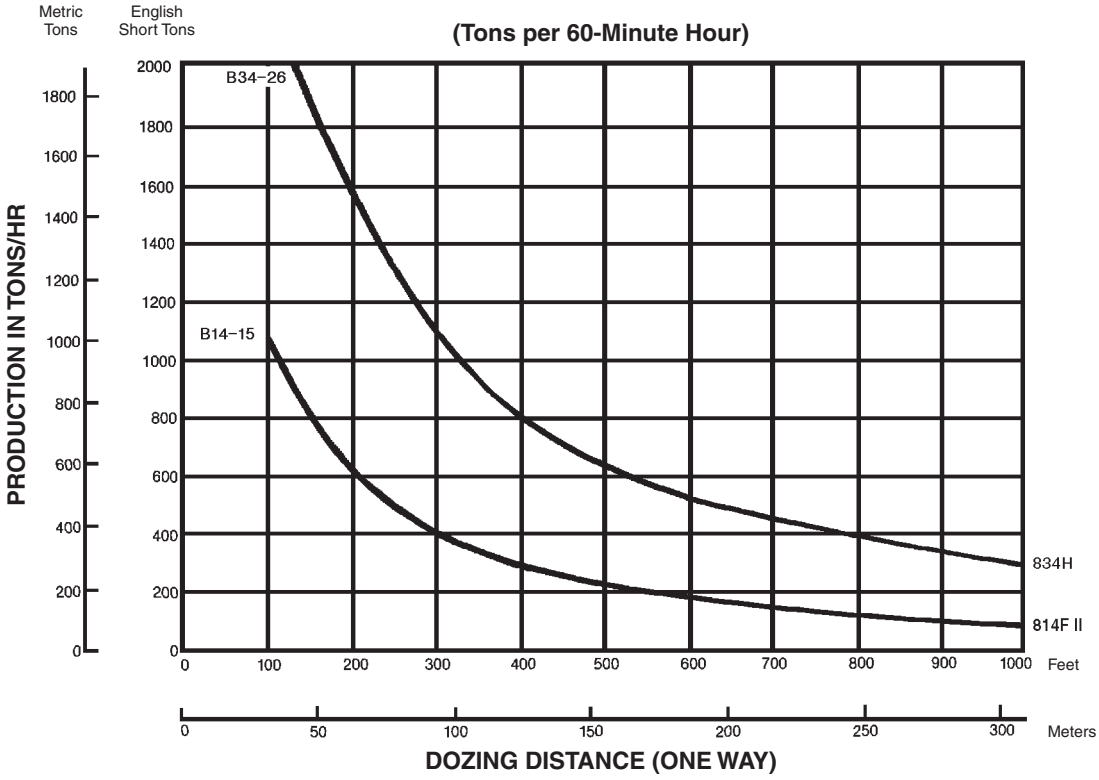
Tractor	U-Blade			Blade Capacities			
	Model	m	ft	Metric tons	U.S. tons	m^3	yd^3
854K	153-2113	7.20	**23'8"**	38.19	**42.26**	44.7	**58.2**
844H	153-2111	5.84	**19'2"**	26.23	**29.02**	30.7	**40.2**
834H	BD834U-20	6.17	**20'3"**	18.80	**20.80**	22.0	**29.0**
824H	BD824U-15	4.79	**15'9"**	14.20	**15.70**	16.1	**21.0**
814F II	BD814U-14	4.32	**14'2"**	9.40	**10.30**	11.0	**14.0**

NOTE: Blade capacities in tons figured using weight of coal at 890 kg/m^3 **(1500 lb/yd^3)**.

Refer to Track-Type Tractor/Bulldozer section for additional special attachment specifications.

Wheel Dozers Estimated Production with Coal Scoop

Factors:
- **Mixed Bituminous Coal**
- **Storage and Reclamation**
- **0% Grade**
- **0.80 Coefficient of Traction**



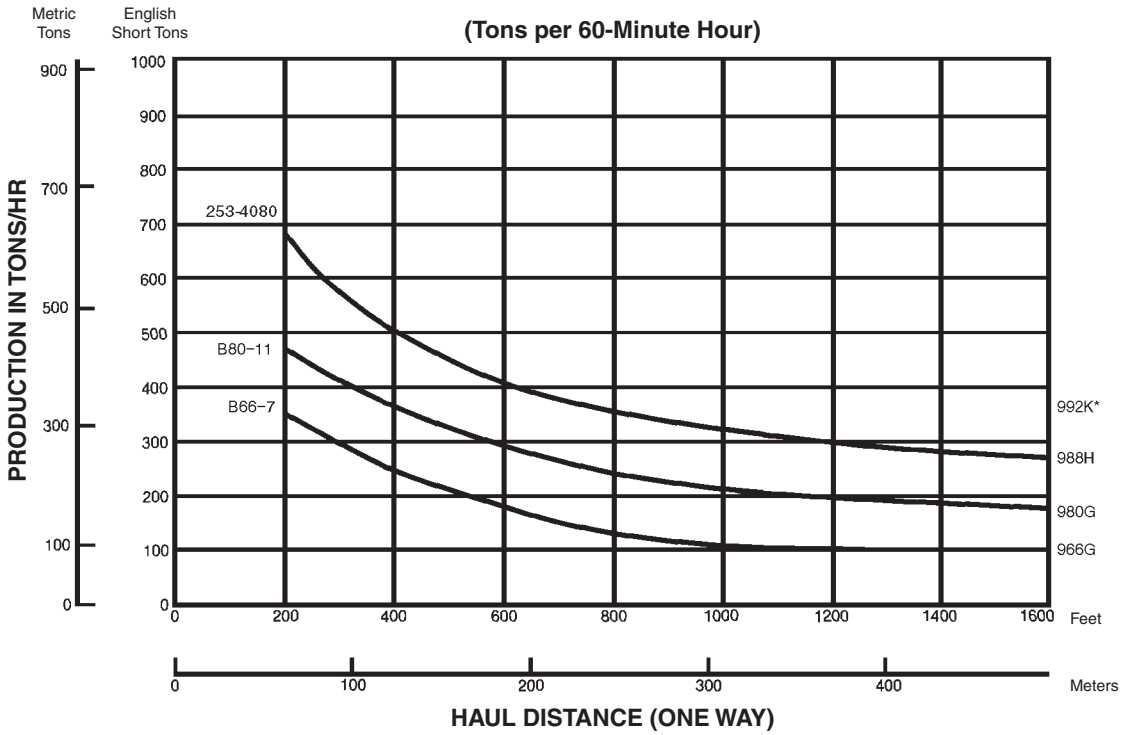
Tractor	Coal Scoop			Scoop Capacities (Lift and Carry)				Doze Capacities			
	Model	m	ft	Metric tons	U.S. tons	m^3	yd^3	Metric tons	U.S. tons	m^3	yd^3
834H	B34-26	5.3	**17'4"**	18.3	**20.2**	19.9	**26**	37.5	**41.25**	37.5	**49**
814F II	B14-15	3.7	**12'3"**	8.2	**9.0**	11.5	**15**	16.3	**18.0**	19.1	**25**

Refer to Track-Type Tractor/Bulldozer section for additional special attachment specifications.

Wheel Loaders Estimated Production with Coal Bucket

Factors:

- **Mixed Bituminous Coal**
- **Storage and Reclamation**
- **0% Grade**
- **0.80 Coefficient of Traction**



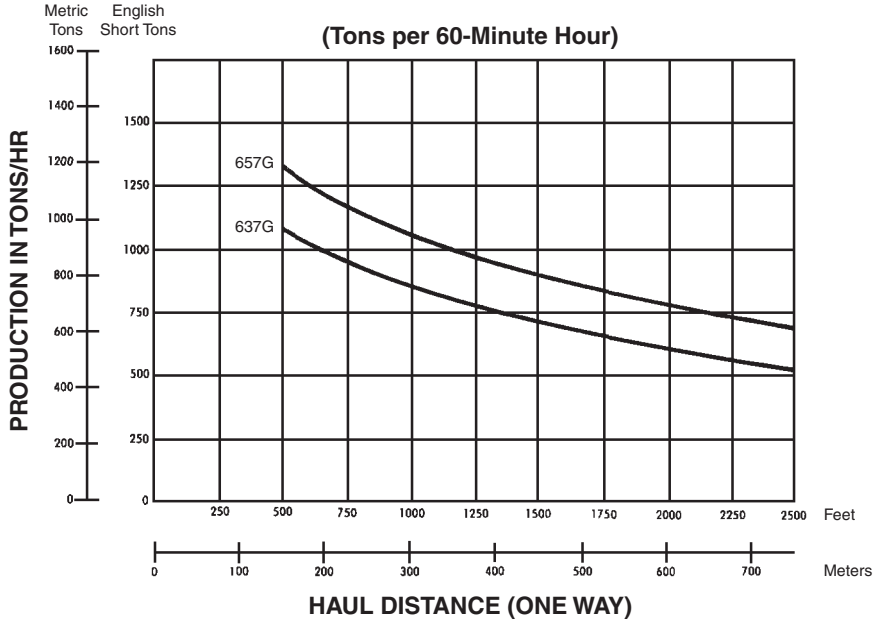
Loader	Coal Bucket Model	Bucket Capacities Metric tons	U.S. tons	m^3	yd^3
992K	294-9020	16.83	**18.61**	19.11	**25.00**
	275-9590	20.19	**22.33**	22.93	**30.00**
988H	253-4080	11.44	**12.65**	12.99	**17.00**
980G	B80-11	7.30	**8.10**	8.20	**10.75**
966G	B66-7	4.80	**5.30**	5.50	**7.25**

*Information unavailable at time of printing.

NOTE: Bucket capacities include bottom cutting edge in tons figured using weight of coal at 890 kg/m^3 **(1500 lb/yd^3)**.

Wheel Tractor-Scrapers Estimated Production

Factors:
- **Mixed Bituminous Coal**
- **Storage and Reclamation**
- **0% Grade**
- **0.50 Coefficient of Traction**



Coal Scraper	Bowl Capacities									
	Metric tons	U.S. tons	Struck		1:1		2:1		3:1	
			m^3	yd^3	m^3	yd^3	m^3	yd^3	m^3	yd^3
657G	49.9	**55**	45	**59**	56	**73**	50	**65**	47	**62**
637G	34.5	**38**	31	**41**	38	**50**	34	**45**	37	**44**

Average fixed time to load, maneuver and dump:
657G — 1.12 min.
637G — 1.10 min.

NOTE:

- The 657G Coal Scraper is 1049 mm (41.3") longer and bowl sides and apron are 1080 mm (42.5") higher than its earthmoving counterpart.
- The 637G Coal Scraper is 762 mm (30") longer and bowl sides, apron and ejector are 915 mm (36") higher than its earthmoving counterpart.
- The rimpull, travel times, and retarder performance for the coal scrapers are the same as for the standard machines. See Wheel Tractor-Scrapers section for charts and graphs.

Example Problem

A coal-fired utility company has a coal requirement of approximately 315 metric tons (350 tons) per hour. Specify the coal handling machine that will satisfy this demand.

Conditions:

Lignite Coal 710 kg/m^3 (1200 lb/yd^3)
90 m (300 ft) push distance
5% adverse grade
50 minute hour operation efficiency

Solution:

Calculate the D9T's production equipped with the BD9U-19 Coal U-Blade by using the D9T production curve. Start at 90 m (300 ft) and read up to the D9T production line, then over to the left to determine its maximum hourly production of 612 metric tons (675 tons).

Since the graphs are based on a 890 kg/m^3 (1500 lb/yd^3) coal density, this production figure has to be adjusted to reflect lignite coal:

Coal density correction factor = 710/890 (1200/1500) = 0.8.

Obtain the production correction factor for the 5% adverse grade from the chart: 0.9.

The correction factor for the 50 minute hour is 50/60 = 0.83.

Now calculate the adjusted D9T hourly production using the correction factors:

Metric $612 \times .8 \times .9 \times .83 = 366$ tons/hour
English $675 \times .8 \times .9 \times .83 = 403$ tons/hour

The D9T falls in the required production range. For short periods of peak power capacity, production could be increased by slot dozing.

Production for the D10T, 824H and 834H can be calculated using the same method.

D10T

Metric $850 \times .8 \times .9 \times .83 = 508$ tons/hour
English $935 \times .8 \times .9 \times .83 = 559$ tons/hour

824H

Metric $400 \times .8 \times .9 \times .83 = 239$ tons/hour
English $440 \times .8 \times .9 \times .83 = 263$ tons/hour

834H

Metric $689 \times .8 \times .9 \times .83 = 412$ tons/hour
English $760 \times .8 \times .9 \times .83 = 454$ tons/hour

Therefore, the D9T or 834H could most economically satisfy the production requirements.

Notes —