

**TECHNICAL MANUAL
DIRECT AND GENERAL SUPPORT AND DEPOT
MAINTENANCE MANUAL
CRANE-SHOVEL BASIC UNIT, CRAWLER MOUNTED,
40 TON, 2 CU YD, DIESEL DRIVEN (W/HARNISCHFEGER ENGINE
MODEL 687C-18-FS) (W/CATERPILLAR ENGINE MODEL D333TA)
(HARNISCHFEGER MODEL 855BG)
FSN 3810-606-8569**

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DIRECT AND GENERAL SUPPORT AND DEPOT MAINTENANCE MANUAL

CRANE-SHOVEL, BASIC UNIT, CRAWLER MOUNTED 40 TON, 2 CU YD, DIESEL DRIVEN (W/HARNISCHFEGER ENGINE MODEL 687C-18-ES)(W/CATERPILLAR ENGINE MODEL D333TA) (HARNISCHFEGER MODEL 855BG) FSN 3810-606-8569

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual contains instructions for the use of direct support, general support and depot maintenance personnel maintaining the crane-shovel basic units, model 855BG, as allocated by the maintenance allocation chart. It provides information on maintenance of the equipment which is beyond the scope of the tools, equipment, personnel, or supplies normally available to organizational maintenance.

b. Report all equipment improvement recommendations as prescribed by TM 38-750.

1-2. Forms and Records

a. DA Forms and records used for equipment maintenance will be only those prescribed in TM 38-750.

b. Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding General, U. S. Army Mobility equipment Command, ATTN: AMSME-MPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

Section II. DESCRIPTION AND DATA

1-3. Description

A general description of the crane-shovel basic unit and information pertaining to the identification plates are contained in TM 5-3810-206-12. A more detailed description of specific components and assemblies are contained in the applicable chapters of this manual.

1-4. Tabulated Data

a. *General.* This paragraph contains all maintenance data pertinent to direct support, general support and depot maintenance personnel. The wiring diagram is located in TM 5-3810-206-12.

b. *Engine Classification and Rating.*

(1) *Engine classification and rating (model 687C-18-ES).*

Manufacturer-----	Harnischfeger
Model-----	687C-18-ES
Cycle-----	2
Bore-----	4.5 in. (inch) (es)
Stroke-----	5.5 in.
Total displacement -----	522 cu in. (cubic inches)
Horsepower-----	190 at 1,700 rpm
-----	(revolutions per minute)
Compression ratio-----	16 to 1
Number cylinders-----	6
Firing order-----	1-6-2-4-3-5
Cooling-----	Liquid cooled

Rotation at flywheel end-----	Counterclockwise
Exhaust spring length with -----	2 3/8 + 1/32-0
valve in closed position	
Exhaust springs load with - -----	105 lb (pound) (s)
valve in closed position	

(2) *Engine classification and rating (model D333TA).*

Manufacturer-----	Caterpillar
Model-----	D333TA
Cycle-----	4
Bore-----	4.5 in.
Stroke-----	5.5 in.
Total displacement -----	522 cu in.
Horsepower (HP) -----	190 HP (without fan)
Number of cylinders-----	6
Firing order-----	1-5-3-6-2-4
Cooling-----	Liquid cooled
Rotation at flywheel end-----	Counterclockwise
Full load rpm -----	2,000
High idle rpm-----	2,180
Low idle rpm -----	600

c. *Generator and Alternator Specifications.*

(1) *Generator specifications (for engine model 687C-18-ES).*

Manufacturer-----	Delco-Remy
Model-----	1117478
Amperes-----	40 at 4,000 rpm
Voltage -----	28 at 4,000 rpm
Rated volts -----	24
Number of brushes-----	4

New brush length-----	15/16 in.
Worn brush length-----	15/32 in.
Spring tension -----	28 oz
Commutator rotation -----	Clockwise

(2) Alternator specifications (for engine model D333TA).

Manufacturer-----	Delco-Remy
Model-----	1117072
Brush spring tension -----	10 oz
Rotation (viewing drive end) -----	Clockwise
Circuit -----	A or B (normally B)
Field current (80° F) Volts -----	24 VDC (volts direct current)
Amp (amperes) -----	3.6 to 4.0
Output (cold):	
Volts -----	24 VDC
Amp -----	61
Approximate rpm -----	2,500

d. Generator and Alternator Regulator Specifications.

(1) Generator regulator specifications (for engine model 687C-18-ES).

Manufacturer-----	Delco-Remy
Model-----	1118558
Volts -----	24
Amperes-----	40
Circuit -----	B
Type-----	Fungus and corrosion
Ground polarity -----	Negative
Voltage regulator	
Air gap -----	0.084 in.
Operating range-----	27.5-29.5 v (volts)
Current regulator:	
Air gap -----	0.115 in.
Operating range-----	38-42 amp (amperes)
Cutout relay:	
Air gap -----	0.048 in.
Point opening -----	0.035 in.
Closing range-----	25-28 v

(2) Alternator regulator specifications (for engine model D333TA).

Manufacturer-----	Delco-Remy
Model-----	9000591
Circuit -----	A or B (normally B)
Polarity -----	Either
	(A circuit for positive ground)
	(B circuit for negative ground)
Voltage setting range -----	27.5 to 28.5 VDC (with adjusting screw at zero)

e. Starter Motor Specifications.

(1) For engine model 687C-18-ES.

Manufacturer-----	Delco-Remy
Model-----	1113757
Rotation-----	Clockwise at drive end
Volts -----	24 VDC
Maximum amperes -----	100 at 8,000 rpm
Minimum torque-----	28 ft-lb (foot-pounds)
Mica undercut-----	1/82-3/64 in.

(2) For engine model D333TA.

Manufacturer-----	Delco-Remy
Model-----	1113771 or 1113818
Volts -----	24 VDC
Rotation-----	Clockwise at drive end
No load test	
Volts -----	23.0
Maximum amperes -----	82.5 for model 1113771 90 for model 1113818
Minimum rpm-----	7,000
Lock test	
Volts -----	3.5
Maximum amp -----	500
Minimum torque-----	26 ft-lb
Minimum brush	
Spring tension -----	80 oz

f. Specific Torque Values.

(1) Engine model 687C-18-ES.

Flywheel capscrew -----	100 ft-lb
Main bearing cap -----	120 ft-lb
Head nut-----	100 ft-lb
Connecting rod nuts -----	50 ft-lb
Pump cam advance screw -----	30 ft-lb
Injector securing nut -----	15-20 ft-lb
Cam lever and support assembly	
securing nut-----	15-20 ft-lb
Injection pump drive shaft nut-----	80 ft-lb
Camshaft- nut-----	100 ft-lb
Exhaust manifold nut-----	50 ft-lb
Crankshaft- gear bolt-----	20-25 ft-lb
Flywheel housing capscrew -----	45 ft-lb
Cam pocket cover capscrew -----	15-20 ft-lb
Main bearing stud -----	100-125 ft-lb
Cylinder head stud -----	50-100 ft-lb
Idler gear bolt -----	30-35 ft-lb
Rocker arm support bolt-----	60 ft-lb
Injector stud-----	15 ft-lb
End plate capscrew -----	45 ft-lb
Rocker arm support nut -----	70 ft-lb

(2) Engine model DS 3TA.

Accessory drive idler gear-----	190-210 ft-lb
Alternator pulley retaining nut-----	60 ft-lb
Camshaft retaining nut-----	190-210 ft-lb
Connecting rod bolt -----	85 ft-lb
Crankshaft main bearing nut-----	155 ft-lb
Crankshaft pulley retaining bolt-----	210-250 ft-lb
Cylinder head (initial)-----	105 ft-lb
Cylinder head (final)-----	155-165 ft-lb
Flywheel retaining bolt -----	130-170 ft-lb
Flywheel housing bolt-----	65-86 ft-lb
Injection pump retaining bushing -----	140-160 ft-lb
Injection nozzle retaining nut-----	100-110 ft-lb
Fuel line nut -----	25-85 ft-lb
Oil pump drive gear retaining nut-----	60 ft-lb
Pre-combustion chamber-----	140-160 ft-lb
Glow plug-----	8-12 ft-lb
Rocker arm cover bolt -----	12-18 ft-lb
Rocker arm shaft retaining bolt -----	95-125 ft-lb
Timing gear housing bolt -----	27-37 ft-lb
Turbocharger compressor cover and turbine housing band clamp bolts -----	120 in.-lb
Turbocharger thrust bearing retaining bolts -----	60 in.-lb
Turbocharger to manifold bolts (using anti-seize compound)-----	36-44 ft-lb

Vibration dampener bolt ----- 65-85 ft-lb
Water pump impeller retaining nut----- 50-55 ft-lb

Allowable tolerance
ambient temperature)

g. Adjustment Data.

Blower speed (ratio) ----- 3.65 to 1
Water pump speed (ratio) -- 3.65 to 1
Air box pressure at 1,800--- 6.4 to 7.8 psi

(1) Engine model 687C-18-ES.

	Allowable tolerance	Limit
Transfer pump pressure at 1,800 rpm-----	100 to 120 lb -----	80 lb
Injector pop pressure -----	2,200 to 2,250 psi -----	2,000 psi (pounds per square inch)
Compression pressure cranking speed at 150-200 rpm-maximum variations of 30 pi between any two cylinders on engine-----	325 to 400 psi-----	250 psi
Injection pump timing, drive-----	26° (degrees) BTC (before top center)	+1°
Pump timing -----	16° BTC-----	-1°
Lift at pushrod -----	0.008 at 86 1/2° ATC (after top center)	
Lift at exhaust valve-----	0.012 at 86 1/2° ATC	
Oil pressure at 1,800 rpm --	52 to 80 psi-----	40 psi
Oil pump capacity -----	44 gpm (gallons per minute)	
Oil pump speed-----	2,743 rpm	
Oil pump pressure relief valve setting-----	65 psi	
Fan speed-----	2,300 rpm	
Water flow -----	90 to 120 gpm (dependent on	

(2) Engine model D333TA.

Alternator belt tension @ 25 lbs -----	will depress 1/2 in.
Fan belt tension-----	will depress 1/2 in.
Fuel injection pump timing (BTC) -----	11°
Fuel injection pump timing dimensions:	
Off engine -----	4.2675 ± .002 in.
On engine -----	4.2255 ± .002 in.
Turbocharger, clearance between Impeller and bearing housing -----	.018-.022 in.
Valve clearance:	
Exhaust (hot)-----	.025 in.
Exhaust (cold) -----	.028 in.
Inlet (hot) -----	.015 in.
Inlet (cold) -----	.017 in.

h. Fuel Injection Pump Torque Data (Engine Model 687C-18-ES).

Transfer pump rotor -----	70-75 in.-lb
Drive hub screw -----	400-500 in.-lb
Drive sprocket -----	95 in.-lb
End plate screws-----	36-39 in.-lb

i. Repair and Replacement Standards. Table 1-1 lists manufacturer's sizes, tolerances, desired clearances, and maximum allowable wear and clearances for engine model D333TA. Table 1-2 lists standards for engine model 687C-18-ES.

Table 1-1. Engine Repair and Replacement Standards For Engine Model D333TA

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance		Maximum allowable wear or clearance
	Minimum	Maximum	Minimum	Maximum	
Accessory Drive:					
Backlash between accessory drive and accessory drive idler gear-----	0.002	0.014			
Backlash Between accessory drive:					
Idler gear and camshaft gear -----	0.002	0.014			
Idler gear end clearance -----	0.002	0.009	-----	-----	0.014
Idler gear bearing base -----	1.000	1.003			
Idler gear bearing clearance -----	0.001	0.005	-----	-----	0.007
Alternator:					
Belt tension (slack at point midway between pulleys 25 lb)-----	-----	0.500			
Camshaft:					
Backlash between camshaft gear and crankshaft gear -----	0.001	0.013			
Bearing journal diameter -----	2.3105	2.3115			
Bearing clearance -----	0.0025	0.0055	-----	-----	0.007
End clearance-----	0.004	0.010	-----	-----	0.017
Connecting Rod:					
Bearing clearance -----	0.0032	0.0061	-----	-----	0.009
Center to center distance -----	8.999	9.001			
Piston pin bearing base -----	1.7009	1.7015			
Crank shaft:					
Main journal diameter-----	3.499	3.500	-----	-----	0.005
Main bearing clearance -----	0.0030	0.0059	-----	-----	0.008
End clearance-----	0.011	0.018	-----	-----	0.027
Connecting rod journal diameter -----	2.999	3.000	-----	-----	0.004
Permissible out-of-round-----	-----	-----	-----	-----	0.002

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance		Maximum allowable wear or clearance
	Minimum	Maximum	Minimum	Maximum	
Cylinder Block:					
Main bearing original base -----	3.8155	3.8165			
Cylinder Liner:					
Inside diameter -----	4.500	4.501	-----	-----	0.004
Counterbore in block -----	0.400	0.402			
Flange thickness -----	0.403	0.405			
Fan Belt Tension:					
Slack at point midway between pulleys -----	-----	0.500			
Fuel Injection Equipment:					
Fuel injection pump timing (Before top center) -----	-----	11°			
Fuel injection pump timing dimension setting (off engine) -----	-----	4.2675	-----	-----	± 0.002
Fuel injection pump timing dimension setting (on engine) with pistons at top center -----	-----	4.2255			± 0.002
Fuel pump plunger length -----	2.5931	2.5937	-----	-----	0.004
Injector nozzle orifice -----	-----	0.025			
Fuel Rack:					
Bearing bore -----	0.5007	0.5013	-----	-----	0.004
Bearing clearance -----	0.002	0.003			
Cam Shaft:					
Bearing bore -----	1.8750	1.8760	-----	-----	0.007
Bearing clearance -----	0.0015	0.0035			
Fuel Transfer Pump:					
Clearance between gears and cover, total -----	0.0010	0.0022	-----	-----	0.0035
Bearing bore -----	0.4950	0.4956			
Shaft diameter -----	0.4936	0.4938			
Bearing clearance -----	0.0012	0.0019	-----	-----	0.003
Governor:					
Backlash between drive gear and driven gear -----	0.002	0.006			
E-Oil Pump:					
Clearance between gears and cover, total -----	0.002	0.004			
Shaft diameter -----	0.7404	0.7410			
Bearing clearance -----	0.0010	0.0026	-----	-----	0.004
Idle Gear:					
Backlash between idler gear and crankshaft gear -----	0.001	0.013			
Bearing bore -----	1.2505	1.2515			
Bearing clearance -----	0.0020	0.0036	-----	-----	0.0065
Drive Gear:					
Backlash between drive gear and idler gear -----	0.001	0.013			
Piston Pins:					
Clearance in rod bearing -----	0.009	0.0019	-----	-----	0.004
Maximum clearance in piston -----	-----	-----	-----	-----	0.004
Piston Rings:					
Piston ring side clearance:					
Top ring -----	0.0030	0.0044	-----	-----	0.007
Intermediate ring -----	0.0025	0.0039			
Oil control ring -----	0.0015	0.0033			
Ring Gap (new liner and rings):					
Top ring -----	0.017	0.023			
Intermediate ring -----	0.018	0.024			
Oil control ring -----	0.013	0.023			
Rocker Arm:					
Bearing bore -----	0.7260	0.7266			
Clearance between shaft and bearing -----	0.0010	0.0026	-----	-----	0.005
Turbocharger:					
Clearance between impeller and bearing housing shaft pushed toward impeller end) -----	0.018	0.022			
End clearance -----	0.004	0.006	-----	-----	0.008
Bearing diameter (ID) -----	0.6880	0.6883			
Bearing diameter (OD) -----	1.0585	0.0590			
Maximum allowable bearing clearance-(satisfactory if compressor wheel and/or turbine wheel bore not rubbed cover or housing) -----					
Journal diameter -----	0.6862	0.6865			
Housing bore diameter -----	1.0625	1.0630			
Thickness of thrust bearing -----	0.225	0.226			

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance		Maximum allowable wear or clearance
	Minimum	Maximum	Minimum	Maximum	
Thickness of thrust rings -----	0.099	0.100			
Width of groove in sleeve -----	0.128	0.130			
Side clearance in groove of sleeve with two ring seals installed side by side -----	0.002	0.006			
Minimum ring seal width -----	-----	-----	-----	-----	0.062
Maximum ring seal groove width -----	-----	-----	-----	-----	0.068
Valves:					
Valve face angle 29 1/4° -----					
Valve seat angle 30° -----					
Valve width:					
Inlet -----	-----	0.076			
Exhaust -----	-----	0.078			
Valve height (top of valve to face of head with valve seated): -----	0.082	0.128			
Inlet -----	0.082	0.128			
Exhaust -----	0.082	0.128			
Exhaust:					
Clearance (hot) -----	0.025				
Clearance (cold) -----	0.028				
Stem clearance in bushing -----	0.003	0.005			
Maximum clearance with new valve -----	-----	-----	-----	-----	0.007
Inlet:					
Clearance (hot) -----	0.015				
Clearance (cold) -----	0.017				
Stem clearance in bushing -----	0.003	0.005			
Maximum clearance with new valve -----	-----	-----			0.007
Valve Lifters:					
Bore diameter -----	1.3125	1.3135			
Lifter diameter -----	1.3100	1.3110			
Maximum clearance -----	-----	-----	-----	-----	0.009
Valve Springs:					
Force when compressed to 21 11/32 in -----	53.20	58.80			
Water Pump:					
Clearance between impeller and housing -----	0.005	0.015			

Table 1-2. Engine Repair and Replacement Standards For Engine Model 687C-18-ES

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance		Maximum allowable wear	Maximum allowable clearance
	Minimum	Maximum	Minimum	Maximum		
Valves:						
Valve clearance (cold) -----	0.012	0.014				
Valve guide-to-stem clearance -----	0.001	0.003	-----	-----		0.007
Rocker arm-to-bushing clearance -----	0.002	0.003	-----	-----	0.006	
Rocker arm-to-pivot clearance -----	0.001	0.002	-----	-----	-----	0.005
Rocker arm bushing-to-shaft clearance -----	0.001	0.004	-----	-----	-----	0.008
Exhaust spring load with valve closed -----	-----	105 lb				
Exhaust spring length with valve in closed position -----	-----	2 3/8 ± 1/32				
CAM FOLLOWER:						
Cam follower roller-to-bushing clearance -----	0.002	0.003	-----	-----	-----	0.006
Cam follower bushing-to-pin clearance -----	0.001	0.002	-----	-----	-----	0.004
PISTON AND PISTON RINGS:						
Piston size top -----	4.473	4.476	-----	-----	4.477	
Piston size bottom -----	4.494	4.496			4.497	
Piston-to-head compression clearance -----	0.012	0.030	-----	-----	-----	0.045
Wrist pin bore, piston -----	1.7490	1.7495				
Compression ring gap -----	0.023	0.028				
Oil ring gap -----	0.016	0.028				
Compression ring axial clearance -----	0.006	0.0075	-----	-----	-----	0.020
2 -----	0.004	0.0055	-----	-----	0.020	
3 and 4 -----	0.002	0.0035	-----	-----	0.020	
Oil ring axial clearance -----	0.001	0.0025	-----	-----	0.006	
Liner size -----	4.500	4.501				