APPLICATION AND INSTALLATION GUIDE

TECHNICAL INFORMATION
3600 DIESEL ENGINES

3606 • 3608
3612 • 3616

CAT®

Contents

Foreword

This section of the Application and Installation Guide lists Technical Information for Cat® engines listed on the cover of this section. Additional engine systems, components and dynamics are addressed in other sections of this Application and Installation Guide.

Engine-specific information and data are available from a variety of sources. Refer to the Introduction section of this guide for additional references.

Systems and components described in this guide may not be available or applicable for every engine.

Technical Information – 3600 Diesel Engines

This guide provides technical data for the Cat 3600 engine family. At the time of publishing, this data is correct; updates will be included periodically and this section republished. Dealers may use the Technical Marketing Information system for the most current data.

SECTION CONTENTS

General Data

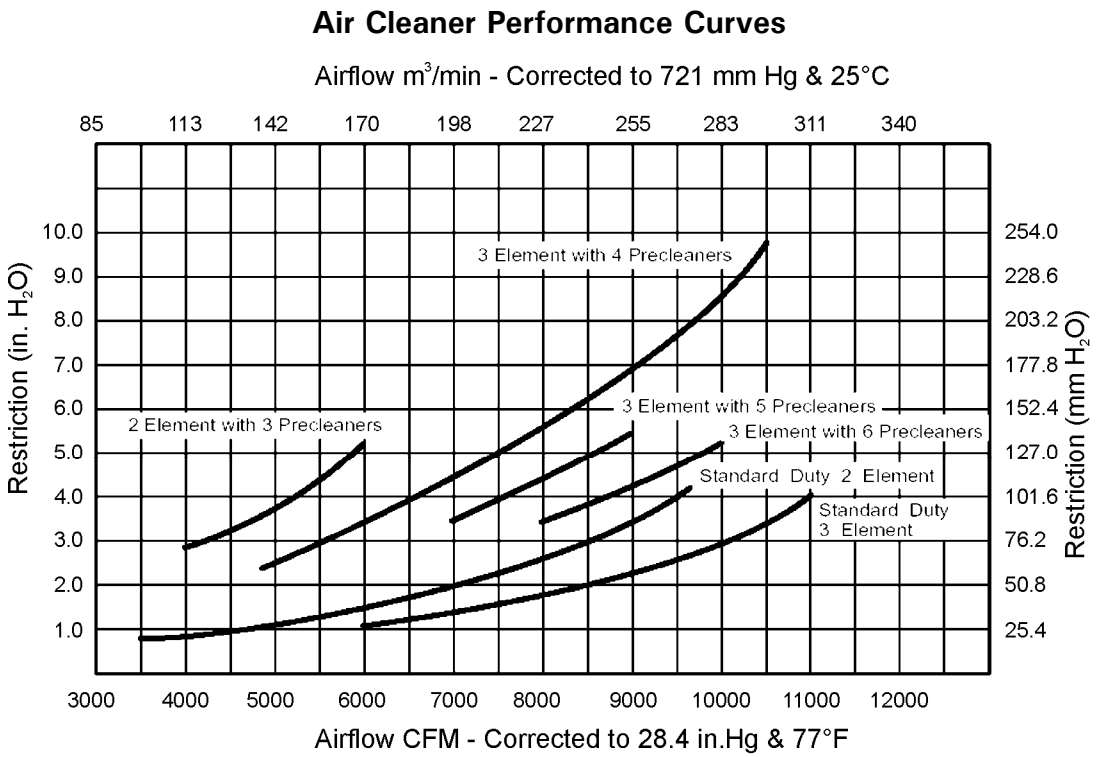
System Description Metric (English)	***3606***	***3608***	***3612***	***3616***
Cylinder Bore mm (in)	280 (11)	280 (11)	280 (11)	280 (11)
Stroke mm (in)	300 (11.8)	300 (11.8)	300 (11.8)	300 (11.8)
Displacement/Cylinder L (in^3)	18.5 (1127)	18.5 (1127)	18.5 (1127)	18.5 (1127)
Firing Pressure, maximum (Continuous/CSR) kPa (psi)	16,200 (2350)	16,200 (2350)	16,200 (2350)	16,200 (2350)
Firing Pressure, maximum (Prime Power/MCR) kPa (psi)	17,334 (2514)	17,334 (2514)	17,334 (2514)	17,334 (2514)
Firing Pressure, maximum (Standby) kPa (psi)	18,500 (2684)	18,500 (2684)	18,500 (2684)	18,500 (2684)
Rated Speed rpm	720 to 1000	720 to 1000	720 to 1000	720 to 1000
Mean Piston Speed m/s (ft/s)	7.2 – 10.0 (23.6 – 32.8)	7.2 – 10.0 (23.6 – 32.8)	7.2 – 10.0 (23.6 – 32.8)	7.2 – 10.0 (23.6 – 32.8)
Idle speed (low) rpm	300 to 400	300 to 400	300 to 400	300 to 400
Idle speed (high) rpm	720 to 1000	720 to 1000	720 to 1000	720 to 1000
Firing Order – CCW	1-5-3-6-2-4	1-6-2-5-8-3-7-4	1-12-9-4-5-8-11-2-3-10-7-6	1-2-5-6-3-4-9-10 -15-16-11-12-13-14-7-8
Firing Order – CW	1-4-2-6-3-5	1-4-7-3-8-5-2-6	1-6-7-10-3-2-11-8-5-4-9-12	1-8-7-14-13-12-11-15 -16-10-9-4-3-6-5-2
Wet weight kg (lb)	16,804 (36,775)	20,221 (44,486)	26,848 (59,065)	32,104 (70,489)
Dry weight kg (lb)	15,680 (34,500)	19,000 (41,800)	25,140 (55,300)	29,950 (65,900)
Center of Gravity Distance from Cylinder Block Rear Face mm (in)	1290 (50.8)	1700 (66.9)	1411 (55.6)	1858 (73.1)
Vertical Distance Above Crankshaft Centerline mm (in)	350 (13.8)	350 (13.8)	380 (14.9)	380 (14.9)
Transverse Distance from Crankshaft Centerline	On Crank Center	On Crank Center	On Crank Center	On Crank Center
NOTE: Center of gravity locations apply to dry runable engines.				

Table 1

Combustion Air System

System Description Metric (English)	*3606*	*3608*	*3612*	*3616*
Air Temperature @ Air Cleaner, maximum °C (°F) @ 150 masl	40 (104)	40 (104)	40 (104))	40 (104)
Air Temperature After Aftercooler (Inlet Manifold), HPAC (50°C water) alarm °C (°F)	78 (172)	78 (172)	78 (172)	78 (172)
Air Temperature After Aftercooler (Inlet Manifold), HPAC (32°C water) alarm °C (°F)	61 (142)	61 (142)	61 (142)	61 (142)
Air Inlet Restriction, new/maximum mm H_2O (in H_2O)	125/380 (5/15)	125/380 (5/15)	125/380 (5/15)	125/380 (5/15)
Aftercooler Pressure Difference @ 100% Load, clean state kPa (psi)	3.4 (0.5)	3.4 (0.5)	3.4 (0.5)	3.4 (0.5)

Table 2



Maximum allowable total inlet restriction should not exceed 3.7 kPa (15 in. H_2O) with dirty air cleaner elements and 1.2 kPa (5 in. H_2O) with initial clean elements.

Air cleaner housings supplied by Caterpillar are provided with an indicator set for a maximum restriction of 3.7 kPa (15 in. H_2O).

Figure 1

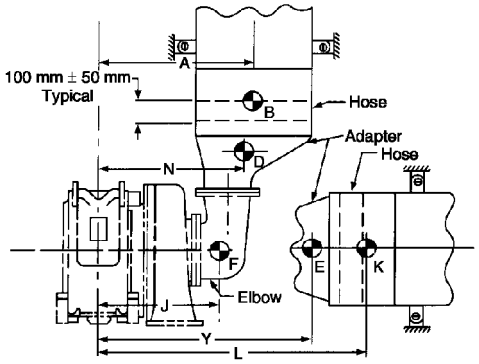
Air Cleaner Weight and Capacity, kg (lb)					
		Clean Element Weight	Dirt Retention Capacity	Total Weight Including Housing	
Duty	Quantity Elements	(Each)	(Each)	Clean	Dirty
Low Volume	2	6.4 (14)	29 (64)	252 (554)	290 (638)
High Volume	3	6.4 (14)	29 (64)	520 (1144)	584 (1285)

Table 3

Loading on Turbocharger Inlet, Maximum

Maximum Loads for ABB VTC Turbocharger Intake

Vertical or axial air inlet



D, F & E = Adapter Weight
B & K = 1/2 Hose Weight
Moment (Vertical Inlet):
$M_V = JF + ND + AB$
Moment (Axial Inlet):
$M_A = YF + LK$

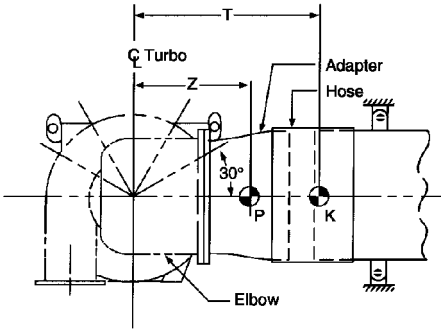
Allowable
Max Moment = 30 mkg

With Caterpillar Supplied Hardware

J = 548 mm	N = 625	A = 700 mm
Y = 705 mm	L = 945 mm	
D = 13 kg	E = 14 kg	F = 16 kg
B = 3 kg / 2	K = 3 kg / 2	

$M_V = 0.548\ (16) + 0.625\ (13) + 0.700\ (1.5)$
$M_V = 18$ mkg which is less than 30 mkg/OK
$M_A = 0.705\ (14) + 0.945\ (1.5) = 11$ mkg which is less than 30 mkg/OK

Horizontal side air inlet



P = Adapter Weight
K = 1/2 Hose Weight
$MS = ZP + TK \leq 7$ mkg

With Caterpillar Hardware
P = 13 kg K = 3 kg / 2

Z = 420 mm T = 500 mm
$M_S = 0.420\ (13) + 0.500\ (3/2) = 6.21 < 7$/OK

Figure 12.

Figure 2

Exhaust Gas System

System Description Metric (English)	*3606*	*3608*	*3612*	*3616*
Exhaust System Backpressure, maximum mm H_2O (in H_2O)	254 (10)	254 (10)	254 (10)	254 (10)
Loading on Turbocharger Outlet, Maximum	For 3600/G3600 series engines, the Caterpillar supplied bellows and adapter, or elbow and bellows options, account for the maximum allowable loading on the turbocharger. All other external piping must be self-supporting.			

Table 4

Loading on Turbocharger Outlet, Maximum

Vertical and Horizontal Exhaust

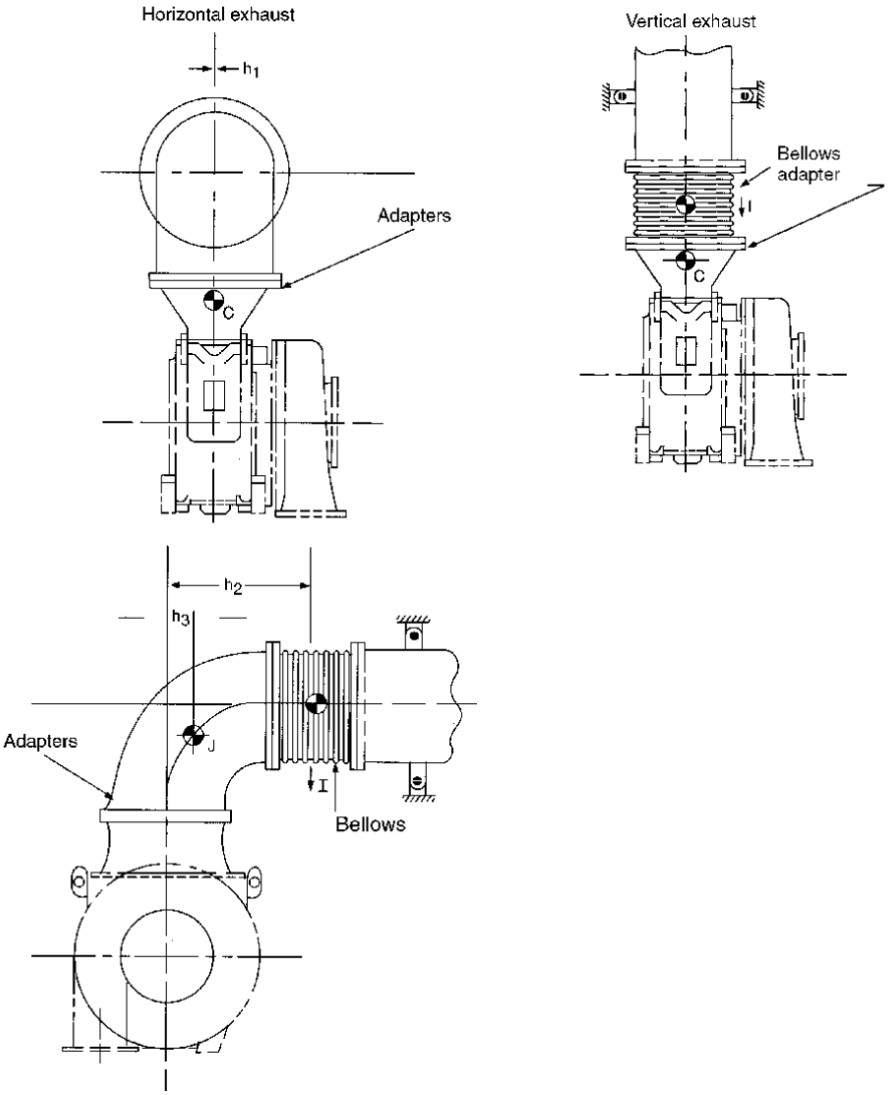


Figure 3

Fuel System

System Description Metric (English)	*3606*	*3608*	*3612*	*3616*
Pump Suction Restriction, maximum kPa (psi)	–20 (–2.9)	–20 (–2.9)	–20 (–2.9)	–20 (–2.9)
Return Line Backpressure, maximum kPa (psi)	350 (51)	350 (51)	350 (51)	350 (51)
Manifold Pressure @ 100% Load kPa (psi) **MUI**	550 +/- 50 (80 +/- 7)	550 +/- 50 (80 +/- 7)	550 +/- 50 (80 +/- 7)	550 +/- 50 (80 +/- 7)
Manifold Pressure @ 100% Load kPa (psi) **EUI**	820 +/- 20 (119 +/- 3)	820 +/- 20 (119 +/- 3)	820 +/- 20 (119 +/- 3)	820 +/- 20 (119 +/- 3)
Emergency Fuel Pump Flow Rate Lpm (gpm)	42 (11)	42 (11)	79 (21)	79 (21)
Fuel Cooler Inlet Temperature Limit °C (°F)	66 (150)	66 (150)	66 (150)	66 (150)

Table 5

Engine Idle Fuel Rates

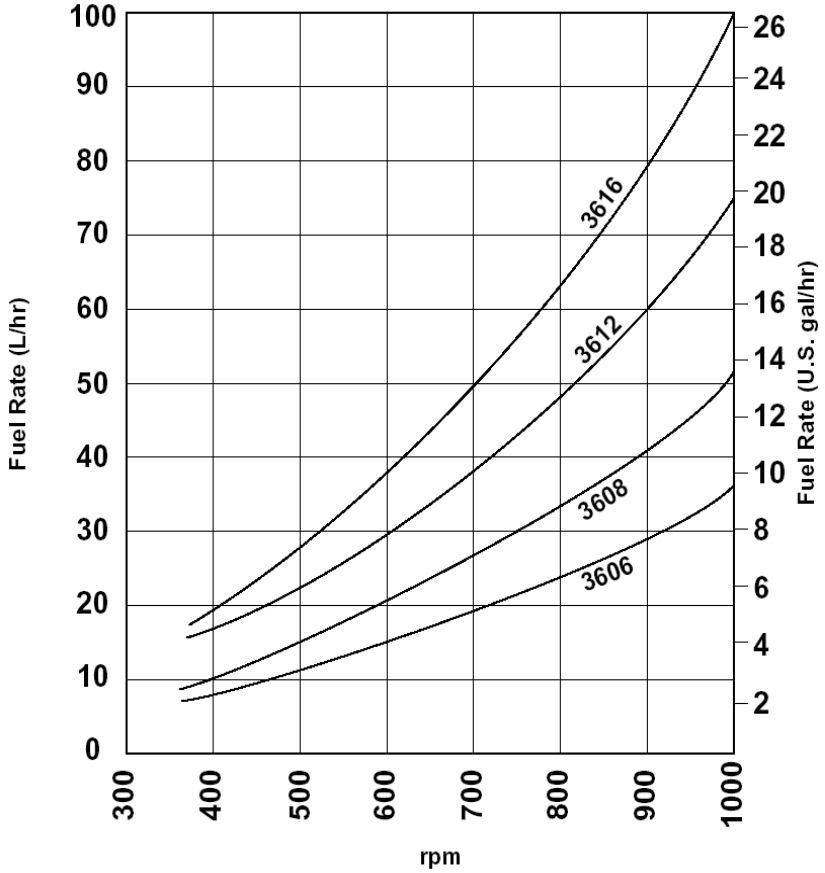


Figure 4

Set up Procedure for the Low-Pressure Fuel System of 3600 and C280 Diesel Engines{1250}

SMCS - 1250-587

Engine:
3606 (S/N: 8RB1-UP)
3608 (S/N: 6MC1-UP; 1ZD1-UP; 5PG1-UP; 8LL1-UP; 7WR1-UP)
3612 (S/N: NZA1-UP; 9RC1-UP; 9FR1-UP)
3616 (S/N: 1PD1-UP; RMN1-UP; 1FN1-UP)
C280-16 (S/N: NKB1-UP; TDX1-UP)

Marine Engine:
C280-12 (S/N: TSJ1-UP; RDW1-UP)
C280-6 (S/N: SCB1-UP; LDL1-UP)
C280-8 (S/N: PKA1-UP; NDT1-UP)

This Special Instruction provides information for proper set-up of the low-pressure fuel system. A low-pressure fuel system that has been set up incorrectly can allow air in the system. Air in the system can cause hard starting, erratic engine operation, and can also erode the unit injectors. This procedure can be used on new and existing installations to check pressure and must be done with clean primary and secondary fuel filters.

Required Tooling

Tooling Part Number	*Description*	*Quantity*
6V-7830	Pressure Gauge	1
214-7568	O-Ring Seal	3
6V-3965	Fitting	2
8C-8456	Cap	3

Table 6

Low-Pressure Fuel System Specifications

NOTICE

If multiple engines are using the same fuel manifold or day tank, operate and load all engines to set the system fuel pressure.

NOTICE

Make sure that the return is routed to the tank and not routed to the engine inlet.

NOTICE

If rated speed and load cannot be achieved, use Tables 7 and 8 to determine the pressure to set at the regulator. This setting is based on load and zero restriction to the transfer pump.

Inlet Fuel Pressure to the Transfer Pump (set at rated speed and load)

- No less than -20 kPa (-3 psi) and no greater than 100 kPa (14.5 psi)
- 50 kPa (7.25 psi) if a priming pump is used

Primary and Secondary Fuel Filter Differential Pressure

- 75 kPa (10.8 psi) maximum

Fuel System Pressure at the Pressure Regulator (set at rated speed and load)

- **MUI:** 550 ± 50 kPa (80 ± 7 psi)
- **EUI:** 820 ± 20 kPa (119 ± 3 psi)

Return Fuel Line Restriction Pressure

- Do not exceed 350 kPa (51 psi) at rated speed and load

Mechanical Unit Injector (MUI)	*With Fuel Transfer Pump Inlet Pressure at 0 kPa*	
Percent of Load	*kPa*	*PSI*
0	879	127
25	864	125
50	850	123
75	835	121
100	820	119

Table 7

Electronic Unit Injector (EUI)	*With Fuel Transfer Pump Inlet Pressure at 0 kPa*	
Percent of Load	*kPa*	*PSI*
0	879	127
25	864	125
50	850	123
75	835	121
100	820	119

Table 8

Locations and Methods for Measuring the Pressures of the Low-Pressure Fuel System

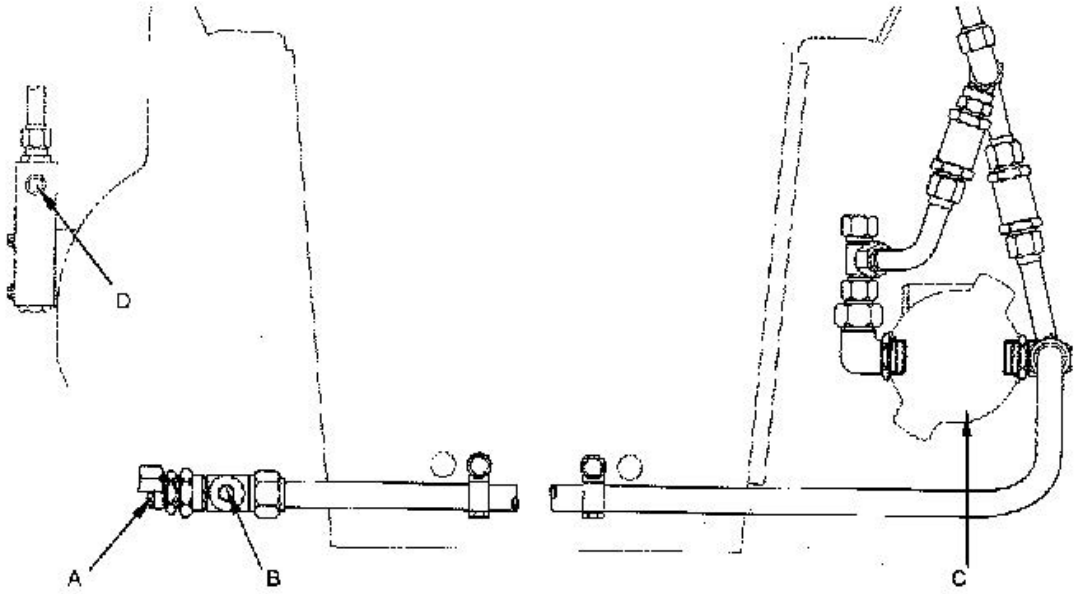


Figure 5

Front View of a typical fuel inlet lines group

(A) Fuel inlet port

(B) Test port for the fuel supply pressure

(C) Fuel transfer pump

(D) Test port location for system pressure

Inlet Fuel Pressure to the Transfer Pump (set at rated speed and load)

1. Install a 6V-3965 Fitting into Port (B) using a 214-7568 O-Ring Seal

   NOTE: The inlet pressure to the fuel transfer pump can affect overall system pressure. All filters or water separators before the transfer pump must be new and clean prior to setting the system pressure at the fuel pressure regulator.

2. Connect the 6V-7830 Pressure Gauge to the fitting installed in the previous step.

3. Set the engine to rated speed and load. Record the fuel pressure, and refer to the specifications above.

Primary and Secondary Fuel Filter Differential Pressure

Primary and secondary fuel filter differential pressures are determined by the pressures from both sides of the fuel filters. This measurement will monitor fuel filter cleanliness and determine when the fuel filters require changing.

Filter replacement will vary depending on fuel quality. Fuel quality can change with each shipment of fuel so monitoring the filter differential is necessary to obtain maximum filter life.

Too high of a differential can cause air bubbles in the fuel system and if not corrected will lead to poor performance and injector damage. After the measurements are taken, refer to the specification above for the maximum allowable differential pressure.

Primary filters or water separators should be properly sized to meet the flow requirements of the engine or engines as well as fuel being returned to the tank. Reference Table 9 for the flow requirements.

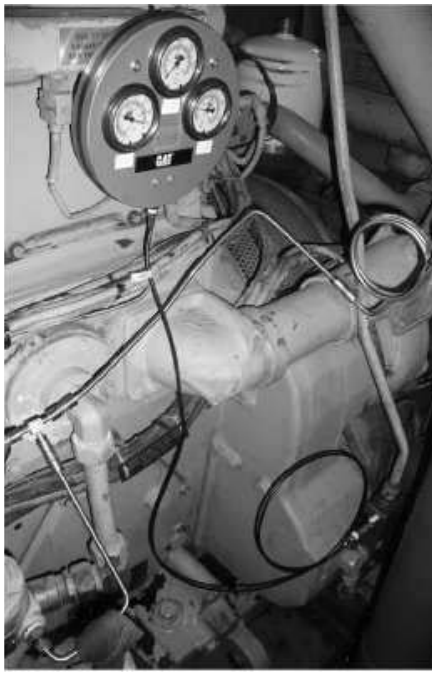
3600 Engine Fuel Flow				
Engine Model	***Rated Speed (rpm)***	***Fuel Flow to Engine***	***Fuel Flow from Engine***	***Fuel Heat Rejection***
3606	1000	41.5 L/min (11 US gpm)	32.4 L/min (8.6 US gpm)	12.5 kW (712 Btu/min)
	900	38 L/min (10 US gpm)	30.0 L/min (7.9 US gpm)	11.0 kW (626 Btu/min)
	750	31.5 L/min (8.3 US gpm)	24.5 L/min (6.5 US gpm)	10.5 kW (598 Btu/min)
	720	30 L/min (7.9 US gpm)	23.6 L/min (6.2 US gpm)	10.0 kW (567 Btu/min)
3608	1000	41.5 L/min (11 US gpm)	30.0 L/min (7.9 US gpm)	16.7 kW (951 Btu/min)
	900	38 L/min (10 US gpm)	27.6 L/min (7.3 US gpm)	14.6 kW (831 Btu/min)
	750	31.5 L/min (8.3 US gpm)	22.6 L/min (6.0 US gpm)	14.0 kW (797 Btu/min)
	720	30 L/min (7.9 US gpm)	21.4 L/min (5.6 US gpm)	13.3 kW (757 Btu/min)
3612	1000	78.5 L/min (20.7 US gpm)	60.1 L/min (15.9 US gpm)	25.0 kW (1423 Btu/min)
	900	72 L/min (19 US gpm)	55.4 L/min (14.6 US gpm)	22.0 kW (1252 Btu/min)
	750	61.2 L/min (16.2 US gpm)	47.3 L/min (12.5 US gpm)	20.2 kW (1150 Btu/min)
	720	58.1 L/min (15.3 US gpm)	45.2 L/min (11.9 US gpm)	19.1 kW (1087 Btu/min)
3616	1000	78.5 L/min (20.7 US gpm)	55.2 L/min (14.6 US gpm)	33.3 kW (1895 Btu/min)
	900	72 L/min (19 US gpm)	51.1 L/min (13.5 US gpm)	29.3 kW (1668 Btu/min)
	750	61.2 L/min (16.2 US gpm)	43.2 L/min (11.4 US gpm)	26.9 kW (1531 Btu/min)
	720	58.1 L/min (15.3 US gpm)	41.2 L/min (10.9 US gpm)	25.4 kW (1446 Btu/min)

Table 9

Fuel System Pressure

1. Install a 6V-3965 Fitting into Port (D) using a 214-7568 O-Ring Seal

   NOTE: The inlet pressure to the fuel transfer pump can affect overall system pressure. All filters or water separators before the transfer pump must be new and clean prior to setting the system pressure at the fuel pressure regulator.



6V-7830 Pressure Gauge installed on the engine

Figure 6

2.Connect the 6V-7830 Pressure Gauge to the fitting installed in the previous step.

3. Set the engine to rated speed and load. Record the fuel pressure, and refer to the specification above.

   NOTE: If multiple engines are using the same fuel manifold or day tank, operate and load all engines to set the system fuel pressure. Multiple engines operating on the same fuel tank or manifold will affect the pressure depending on the number of engines running and the fuel demand.

   NOTE: If rated speed and load cannot be achieved, use Tables 7 and 7 to determine the pressure to set at the regulator. This setting is based on load and zero restriction to the transfer pump.

4. With the 6V-7830 Pressure Gauge connected to the fuel pressure regulator, adjust the regulator until the desired pressure is obtained.

Return Fuel Line Restriction Pressure

This pressure is taken after the fuel pressure regulator in the customer supplied piping. Measure this pressure directly after the fuel pressure regulator, before any other fuel system components.

NOTE: All pressures can be documented on the attached Check Sheet (Figure 7) for future reference

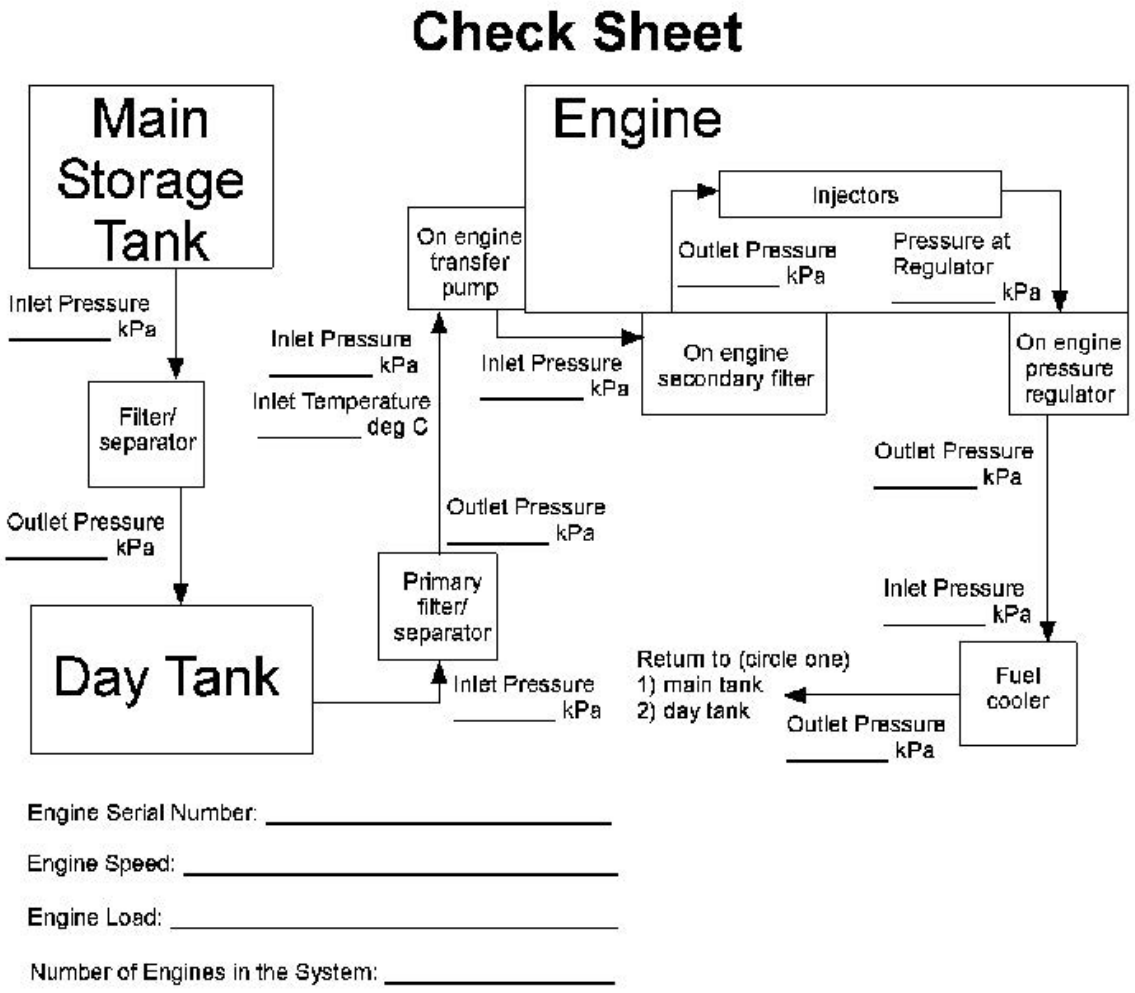


Figure 7

Lubricating Oil System

System Description Metric (English)	*3606*	*3608*	*3612*	*3616*
Manifold Pressure, nominal kPa (psi)	380 (55)	380 (55)	380 (55)	380 (55)
Manifold Pressure, alarm (650 – 1000 rpm) kPa (psi)	320 (46)	320 (46)	320 (46)	320 (46)
Manifold Pressure, alarm (0 – 650 rpm) kPa (psi)	120 (17)	120 (17)	120 (17)	120 (17)
Manifold Pressure, stop (650 – 1000 rpm) kPa (psi)	260 (38)	260 (38)	260 (38)	260 (38)
Manifold Pressure, stop (0 – 650 rpm) kPa (psi)	105 (15)	105 (15)	105 (15)	105 (15)
Manifold Temperature, alarm °C (°F)	92 (198)	92 (198)	92 (198)	92 (198)
Manifold Temperature, stop °C (°F)	98 (208)	98 (208)	98 (208)	98 (208)
Manifold Temperature, nominal °C (°F)	85 (185)	85 (185)	85 (185)	85 (185)
Prelube Pump Capacity, intermittent (pneumatic) Lpm (gpm)	76 (20)	76 (20)	76 (20)	76 (20)
Prelube Pump Capacity, intermittent (electric) Lpm (gpm)	50 – 65 (13 – 17)	50 – 65 (13 – 17)	50 – 65 (13 – 17)	50 – 65 (13 – 17)
Prelube Pump Capacity, continuous Lpm (gpm)	23 (6)	23 (6)	23 (6)	23 (6)
BSOC @ 100% Load, typical g/bkW-hr (lb/bhp-hr)	0.7 (0.0012)	0.7 (0.0012)	0.7 (0.0012)	0.7 (0.0012)
Lube Oil Filter Differential Pressure, maximum kPa (psi)	104 (15)	104 (15)	104 (15)	104 (15)
Lube Oil Flow Lpm (gpm)	577 (152)	728 (192)	868 (229)	1117 (295)
Emergency Oil Pump Flow Rate Lpm (gpm)	750 (198)	770 (203)	890 (235)	1200 (317)

Table 10

Lube Oil Capacities and Oil Change Intervals for 3600 (Distillate Fuel)						
Engine	Industrial Engines and Generator Set Engines		Marine Engines (Zero Degree Tilt)		Engines with Shallow Oil Pan for Restricted Clearance Applications	
	Lube Oil Capacity[1] L (US gal)	Oil Change Interval[2] Service Hours	Lube Oil Capacity[1] L (US gal)	Oil Change Interval[2] Service Hours	Lube Oil Capacity[1] L (US gal)	Oil Change Interval[2] Service Hours
3606	830 (229)	1400	731 (190)	1000	784 (207)	1250
3608	1112 (289)	1350	795 (207)	900		
3612	1302 (339)	1000	943 (245)	800	946 (250)	800
3616	1677 (443)	1000	1051(284)	600		

(1) The capacity includes the oil sump plus oil filters that are installed at the factory. Engines with auxiliary oil filters will require additional oil. The capacity is approximate. The actual capacity may vary by 5 percent. Caterpillar recommends using the capacity that is listed and then adjusting the oil level according to the oil level gauge (dipstick).

(2) Use this oil change interval in the absence of oil analysis.

Table 11

Tilt Angle Capability

Continuous Tilt Angle Capability								
	Marine Propulsion						Marine Auxiliary	
Tilt Criteria	+/- 10° Trim & +/- 22.5° List (any combination)						+/- 10° Trim & +/- 22.5° List (any combination)	
	Installation Angle / Rear Down (Degrees)						Level Installation	
Engine Model	0	1	2	3	4	5		
3606	X	X	X	X	X	X	X	
3608	X	X	X	S	S	S	X	
3612	X	X	X	X	X	X	X	
(Standard Pan)								
3612	Y	Y	Y	Y	Y	D	Y	
(Shallow Pan)								
3616	X	X	X	X	S	S	X	

X = Standard Sump, capable of meeting the indicated tilt criteria.

Y = Optional Sump for 3612, capable of meeting the indicated tilt criteria.

S = Requires increased depth oil sump (special order)

D = Requires Dry Sump option to achieve the indicated tilt criteria.

Figure 8

NOTE: If the sump engine is installed at >0° tilt, it will reduce oil capacity and reduce the oil change interval. Consult Caterpillar for specific details.

Cooling Water System

Block Cooling

System Description Metric (English)	3606	3608	3612	3616
Inlet Temperature, nominal °C (°F)	90 (194)	90 (194)	90 (194)	90 (194)
Inlet Temperature, maximum °C (°F)	95 (203)	95 (203)	95 (203)	95 (203)
Inlet Temperature, minimum °C (°F)	83 (181)	83 (181)	83 (181)	83 (181)
Outlet Temp Before Regulator, maximum °C (°F)	99 (210)	99 (210)	99 (210)	99 (210)
Outlet Temperature, alarm °C (°F)	103 (217)	103 (217)	103 (217)	103 (217)
Outlet Temperature, stop °C (°F)	109 (228)	109 (228)	109 (228)	109 (228)
Minimum System Pressure, alarm kPa (psi)	70 (10)	70 (10)	70 (10)	70 (10)
Pump Inlet Pressure, minimum kPa (psi)	30 (4.3)	30 (4.3)	30 (4.3)	30 (4.3)

Table 12

Water Pump Capacity & Water Pump Rise								
	AC/OC Pump @ 32°C-				JW Pump @ 90°C			
	Flow		Rise		Flow		Rise	
	L/min	gpm	kPa	psi	L/min	gpm	kPa	psi
3606/3608								
1000 rpm	1200	317	295	42.8	1460	385	295	42.8
900 rpm	1080	285	240	34.8	1315	347	240	34.8
750 rpm	900	238	170	24.7	1095	289	170	24.7
720 rpm	860	227	160	23.2	1050	277	160	23.2
3612/3616								
1000 rpm	1730	457	305	44.3	2920	771	290	42.1
900 rpm	1560	412	245	35.6	2630	694	240	34.8
750 rpm	1300	343	170	24.7	2190	578	170	24.7
720 rpm	1250	330	160	23.2	2100	554	155	22.5

Table 13

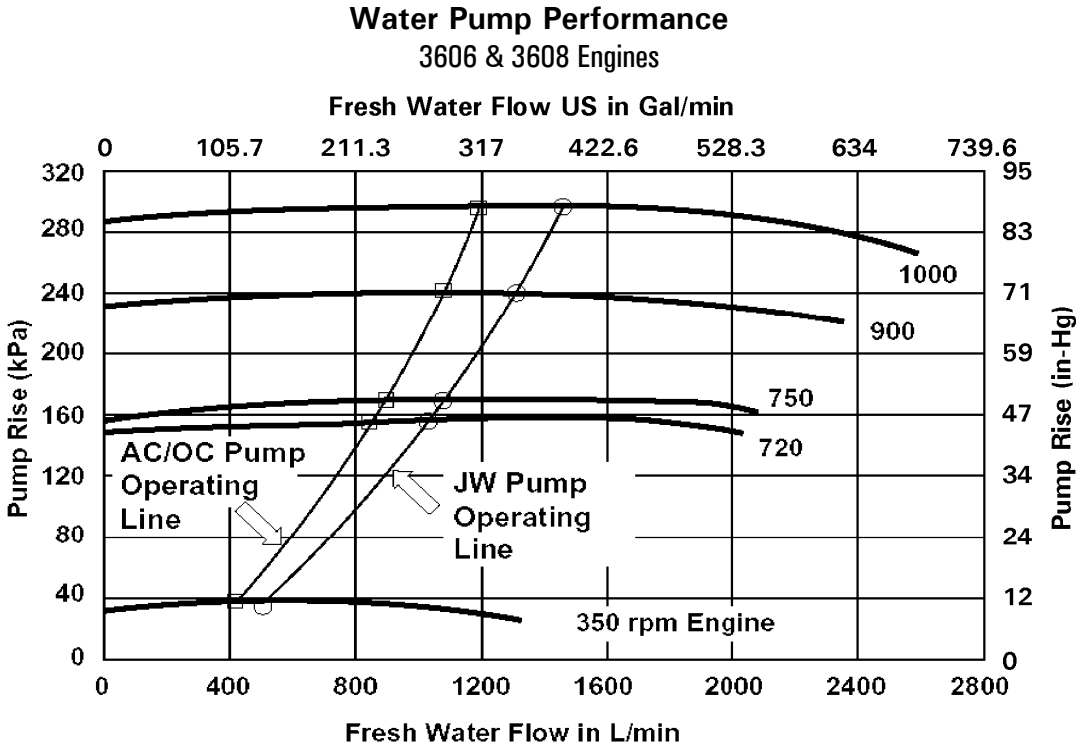


Figure 9

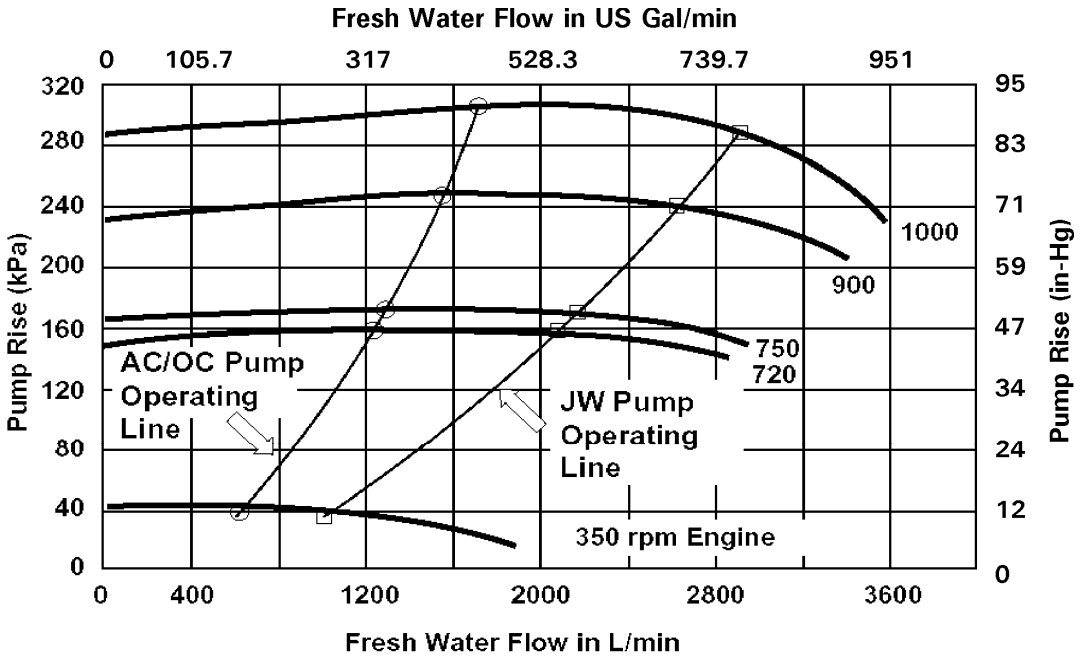
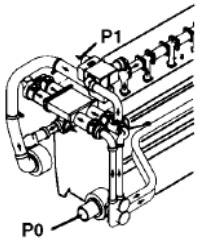


Figure 10

External Cooling System Pressure Drop

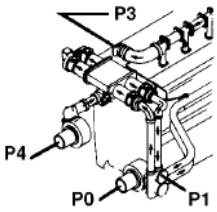
3606 and 3608 Combined Circuit

External Circuit Resistance, kPa (psi)



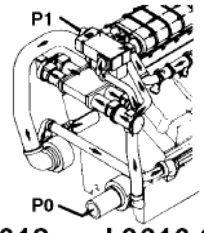
Engine Speed rpm	Low Temperature Circuit Δ P (P1-P2)	High Temperature Circuit Δ P (P3-P4)
1000	91 (13)	—
900	71 (10)	—
750	45 (6.5)	—
720	40 (5.8)	—
Tolerance:	± 10%	—

3606 and 3608 Separate Circuit



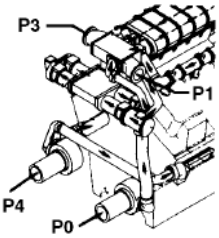
1000	104 (15)	99 (14)
900	84(12)	77 (11)
750	58 (8)	50 (7)
720	52 (7.5)	44 (6)
Tolerance:	± 10%	± 10%

3612 and 3616 Combined Circuit



1000	85 (12)	—
900	66 (9.6)	—
750	42 (6)	—
720	38 (5.5)	—
Tolerance:	± 10%	—

3612 and 3616 Separate Circuit



1000	85 (12)	103 (15)
900	66 (9.6)	81 (12)
750	42 (6)	52 (7.5)
720	38 (5.5)	47 (7)
Tolerance:	± 10%	± 10%

Figure 11

NOTE: The above external resistance settings must be made with blocked-open regulators to assure full heat exchanger flow. Refer to Engine Data Sheet Cooling System Field Test.

NOTE: A lockable plug valve is preferred for setting external resistance. A plate type orifice or other adjustable valve may be used, but it must not include an elastomer seal element.

Sea Water Cooling

System Description Metric (English)	*3606*	*3608*	*3612*	*3616*
Minimum System Pressure, alarm kPa (psi)	70 (10)	70 (10)	70 (10)	70 (10)

Table 14

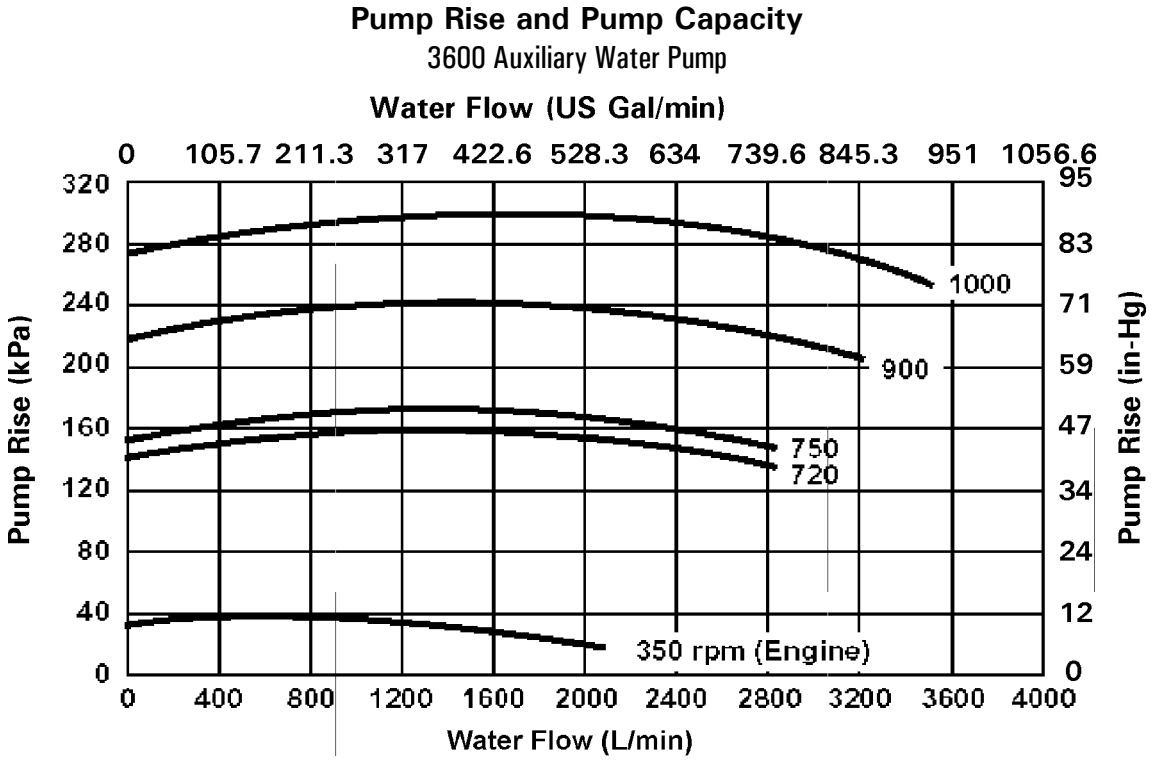


Figure 12

Starting Air System

System Description Metric (English)	*3606*	*3608*	*3612*	*3616*
Air Pressure, nominal kPa (psi)	1225 (175)	1225 (175)	1225 (175)	1225 (175)
Air Pressure, minimum kPa (psi)	620 (90)	620 (90)	620 (90)	620 (90)
Air Pressure, maximum (Vane Starters) kPa (psi)	1575 (225)	1575 (225)	1575 (225)	1575 (225)
Low Air Pressure, alarm kPa (psi)	750 (109)	750 (109)	750 (109)	750 (109)

Table 15

Vane Starter Performance Curves

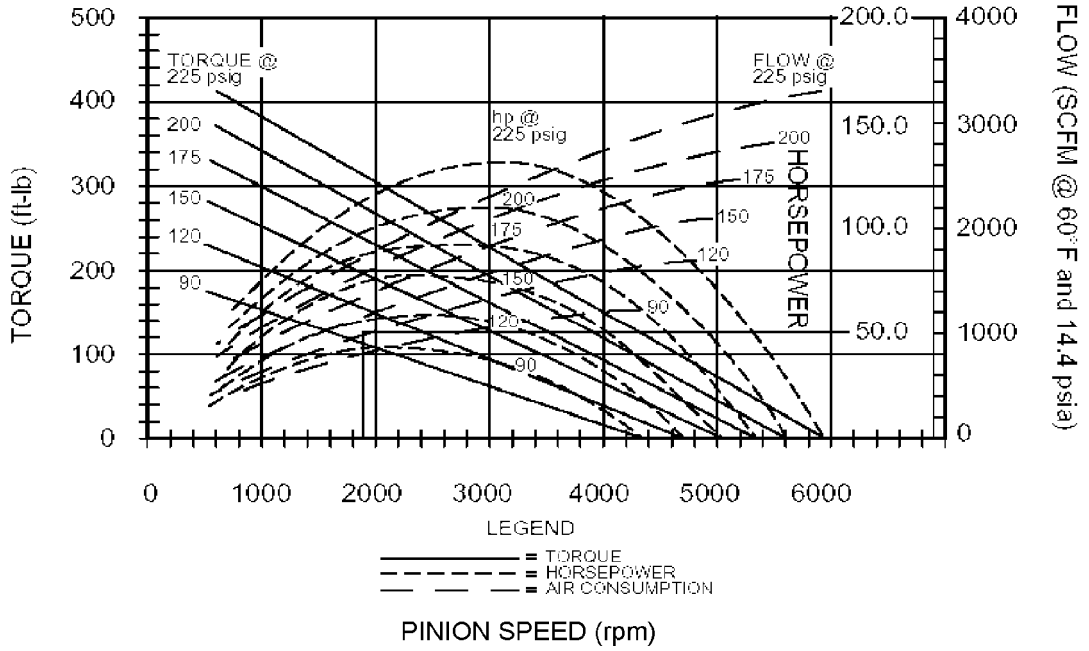


Figure 13

Air Start Tank Sizing

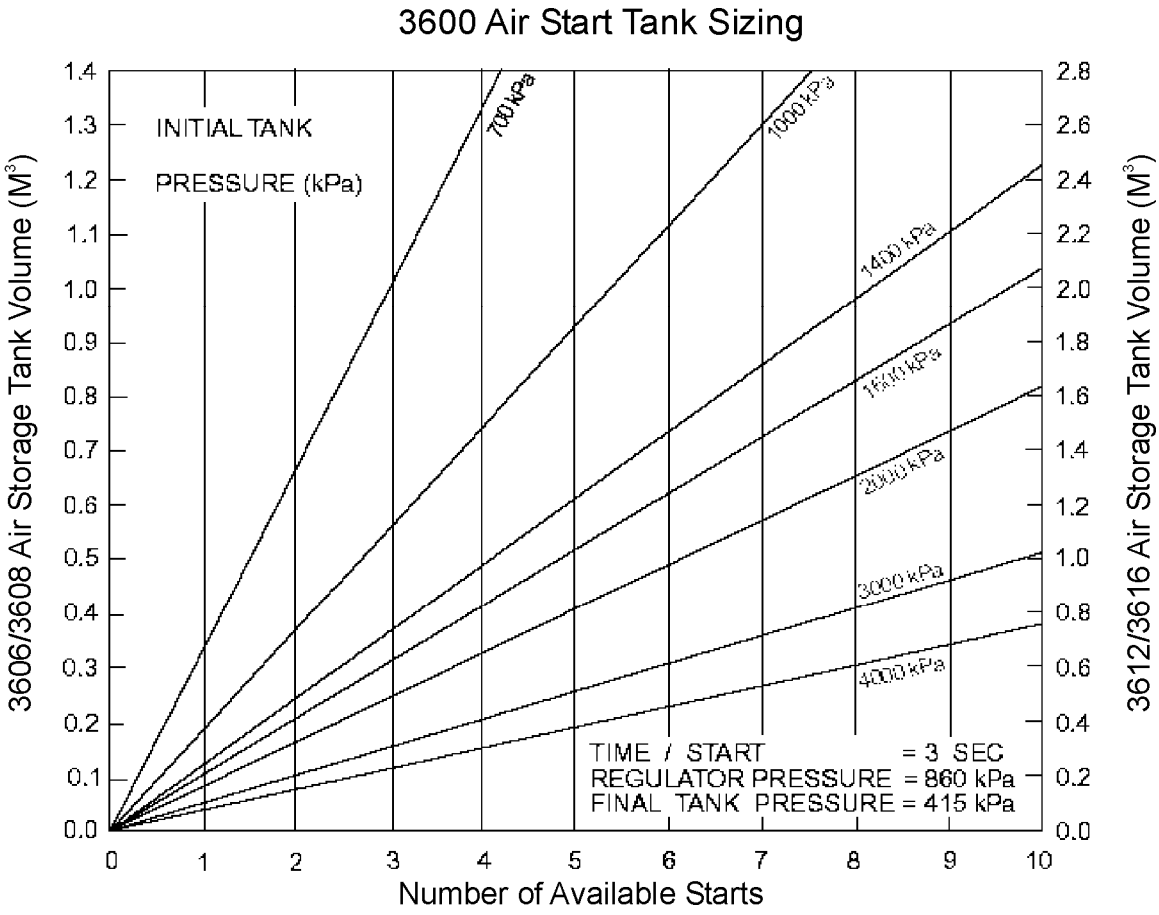


Figure 14

Starter Pressures and Flows

Static Regulator Outlet Pressure kPag (psig)	*Estimated Dynamic Pressure at the Starter kPag (psig)*	*Air Flow Capacity Per Starter L/sec (SCFM)*
862 (125	620 – 655 (90 – 95)	400 (720)
1550 (225)	1172 (170)	615 (1300)

Table 16

Power Supply Requirements

System Description Metric (English)	*3606*	*3608*	*3612*	*3616*
Jacket Water Heater (Optional) kW (Btu/min)	18 (1024)	18 (1024)	30 (1706)	30 (1706)
Lube Oil Heater (Optional) kW (Btu/min)	9 (512)	9 (512)	9 (512)	9 (512)
Combination Jacket Water/Lube Oil Heater (Optional) kW (Btu/min)	18/9 (1024/512)	18/9 (1024/512)	30/9 (1706/512)	30/9 (1706/512)

Table 17

Additional Data

Torsional Vibration Analysis Information

EPG Applications

Application	Rated Speed (rpm)	Engines			
		3606	3608	3612	3616
Two bearing	720	A	B	E	H
Two bearing	750	A	B	E	H
Two bearing	900	A	C	F	I
Two bearing	1000	A	C	F	I

Table 18

Damper Data	A	B	C	D	E	F	G	H	I	J
Lumped mass J*	6.56	6.56	29.29	46.15	22.82	26.29	22.82	22.82	6.56	22.82
Separated Damper Data										
Damper Housing J*	3.64	3.64	11.69	17.25	8.37	11.69	8.37	8.37	3.64	8.37
Damper Flywheel J*	5.84	5.84	29.2	57.80	28.90	29.20	28.90	28.90	5.84	28.90
Damper Constant C	1243	1000	14123	22500	5100	7000	6600	7500	1500	8100
Damper Rigidity K	0.73	0.41	4.52	6.50	1.80	2.85	1.60	1.48	0.60	1.35

* Add to Front of Crank J (N•m sec) K (N•m x 10^6/radian) C (N•m sec/radian)

Table 19

Torsional Calculation Values

- Reciprocating Mass per Cylinder = 68.36 kg (150.71 lb)
- Rotating Mass per Cylinder = 39.61 kg (87.33 lb)
- Connecting Rod Length (between pin centers) = 600 mm (23.62 in)

Cyclic Irregularity

Calculated Cyclic Irregularities		
	Speed-rpm	
Engine	900	1000
3606	1:152	1:188
3608	1:145	1:179
3612	1:254	1:314
3616	1:450	1:556

Table 20

Empirical Damping

Engine	N•m sec per radian
3606	384
3608	441
3612	531
3616	531

Table 21

NOTE: The damping values for the inline engines are for each cylinder; the 3612 and 3616 damping values are for a pair of cylinders since the vee engines have two cylinders on each crankshaft throw.

Flywheel Inertia Data

Most marine propulsion applications use the high inertia flywheel to allow the use of a single element torsional coupling. A lighter weight standard flywheel is also available. Inertia valves include the ring gear and should be added to the rear crank inertia.

- Standard Flywheel Inertia = 74.90 N•m sec^2
- High Inertia Flywheel; = 140.29 N•m sec^2

For Harmonic Component of Tangential Pressure, see TD3310 at the bottom of each TVA table.

Torsional Vibration Data – Model 3606

Degrees to Firing After #1 Fires		Engine	J	K	Minimum Diameter
CW (Reverse) Rotation	CCW (Standard) Rotation				
		Front Crank	5.4652		
		|		72.53	216
0	0	Cylinder #1	9.743		
		|		42.85	216
240	480	Cylinder #2	8.685		
		|		42.85	216
480	240	Cylinder #3	8.685		
		|		42.85	216
120	600	Cylinder #4	8.685		
		|		42.85	216
600	120	Cylinder #5	8.685		
		|		42.85	216
360	360	Cylinder #6	9.743		
		|		72.53	216
		Rear Crank	5.8060		

J = N•m sec^2

K = N•m x 10^6 /radian

C = N•m sec/radian

Diameter in millimeters

Total Inertia without Flywheel and Damper: J = 65.50 N•m sec^2

For Harmonic Component of Tangential Pressure, see TD3310 at the bottom of each TVA table.

Table 22

Torsional Vibration Data – Model 3608

Front Driven Equipment					
3608 Mass Elastic System					
Degrees to Firing After #1 Fires		*Engine*	*J*	*K*	*Minimum Diameter*
CW (Reverse) Rotation	*CCW (Standard) Rotation*				
		Front Crank	5.6452		
		|		69.28	216
0	0	Cylinder #1	9.434		
		|		41.50	216
540	180	Cylinder #2	8.997		
		|		41.50	216
270	450	Cylinder #3	8.997		
		|		41.50	216
90	630	Cylinder #4	8.997		
		|		41.50	216
450	270	Cylinder #5	8.997		
		|		41.50	216
630	90	Cylinder #6	8.997		
		|		41.50	216
180	540	Cylinder #7	8.997		
		|		41.50	216
360	360	Cylinder #8	9.434		
		|		69.28	216
		Rear Crank	5.9203		

J = N•m sec^2

K = N•m x 10^6 /radian

C = N•m sec/radian

Diameter in millimeters

Total Inertia without Flywheel and Damper: J = 84.42 N•m sec^2

For Harmonic component of Tangential Pressure, see TD3310 at the bottom of each TVA table.

Table 23

Torsional Vibration Data – Model 3612

Degrees to Firing After #1 Fires				Engine	J	K	Minimum Diameter
CW (Reversed) Rotation		CCW (Standard) Rotation					
				Front Crank	5.6452		
						67.79	216
1R-0	1L-290	1R-0	1L-410	Cylinder #1	17.00		
						40.11	216
2R-240	2L-530	2R-480	2L-170	Cylinder #2	16.31		
						40.11	216
3R-480	3L-50	3R-240	3L-650	Cylinder #3	16.31		
						40.11	216
4R120	4L-410	4R-600	4L-290	Cylinder #4	16.31		
						40.11	216
5R-600	5L-170	5R-120	5L-530	Cylinder #5	16.31		
						40.11	216
6R-310	6L-650	6R-360	6L-50	Cylinder #6	17.00		
						67.79	216
				Rear Crank	5.8263		

J = N•m sec^2

K = N•m x 10^6 /radian

C = N•m sec/radian

Diameter in millimeters

Total Inertia without Flywheel and Damper: J = 110.71 N•m sec^2

For Harmonic component of Tangential Pressure, see TD3310 at the bottom of each TVA table.

Table 24

Torsional Vibration Data – Model 3616

Degrees to Firing After #1 Fires				Engine	J	K	Minimum Diameter
CW (Reversed) Rotation		CCW (Standard) Rotation					
				Front Crank	5.6452		
						67.79	216
1R-0	1L-680	1R-0	1L-50	Cylinder #1	17.17		
						40.11	216
2R-540	2L-500	2R-180	2L-230	Cylinder #2	16.50		
						40.11	216
3R-630	3L-590	3R-90	3L-140	Cylinder #3	16.50		
						40.11	216
4R-90	4L-50	4R-630	4L-680	Cylinder #4	16.50		
						40.11	216
5R-450	5L-410	5R-270	5L-320	Cylinder #5	16.50		
						40.11	216
6R-270	6L-230	6R-450	6L-500	Cylinder #6	16.50		
						40.11	216
7R-180	7L-140	7R-540	7L-590	Cylinder #7	16.50		
						40.11	216
8R-360	8L-320	8R360	8L-410	Cylinder #8	17.17		
						67.79	216
				Rear Crank	5.8263		

J = N•m sec^2

K = N•m x 10^6 /radian

C = N•m sec/radian

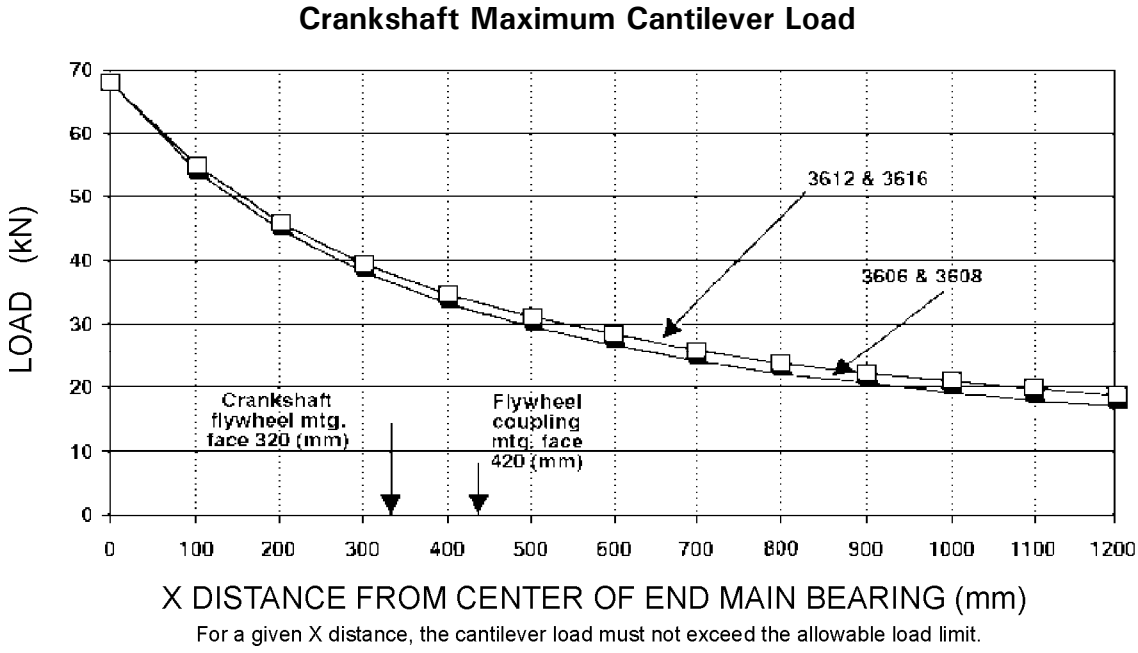
Diameter in millimeters

Total Inertia without Flywheel and Damper: J = 144.81 N•m sec^2

For Harmonic component of Tangential Pressure, see TD3310 at the bottom of each TVA table.

Table 25

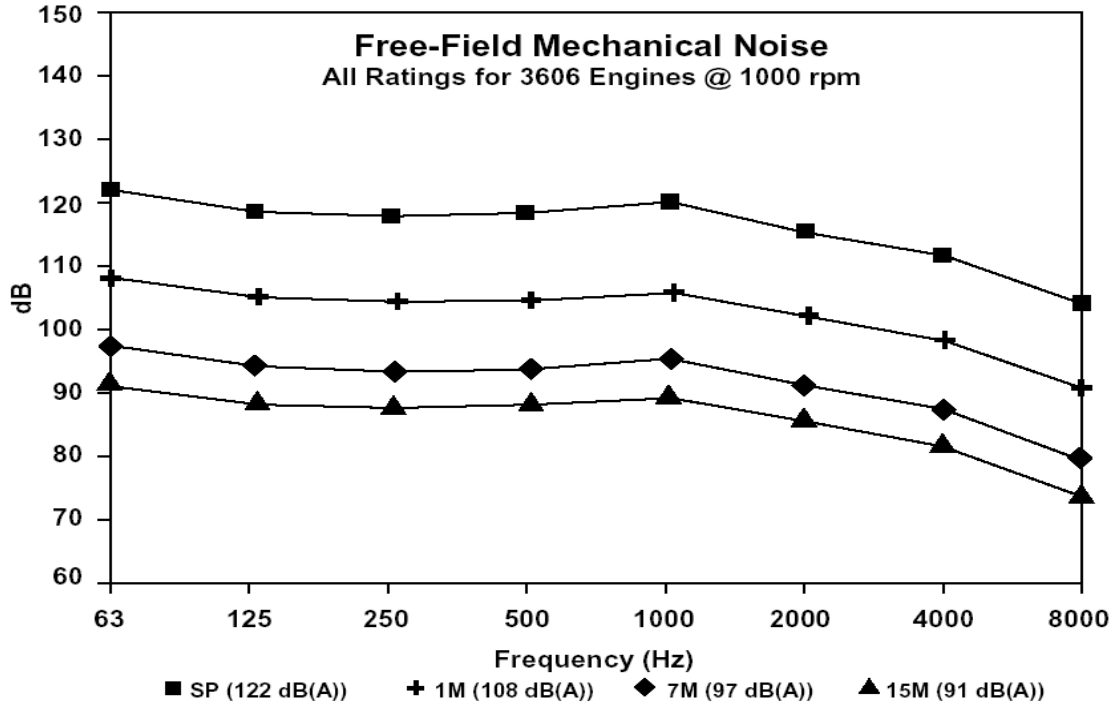
Crankshaft Cantilever Load



For a given X distance, the cantilever load must not exceed the allowable load limit.

Figure 15

Free-Field Mechanical Noise



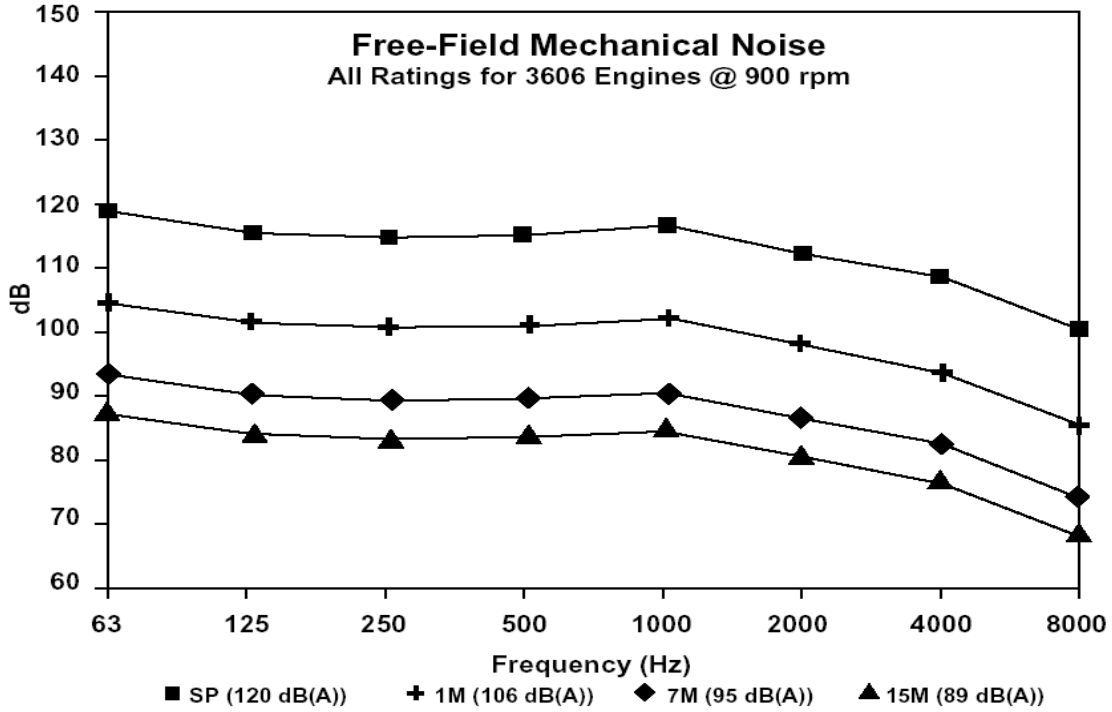
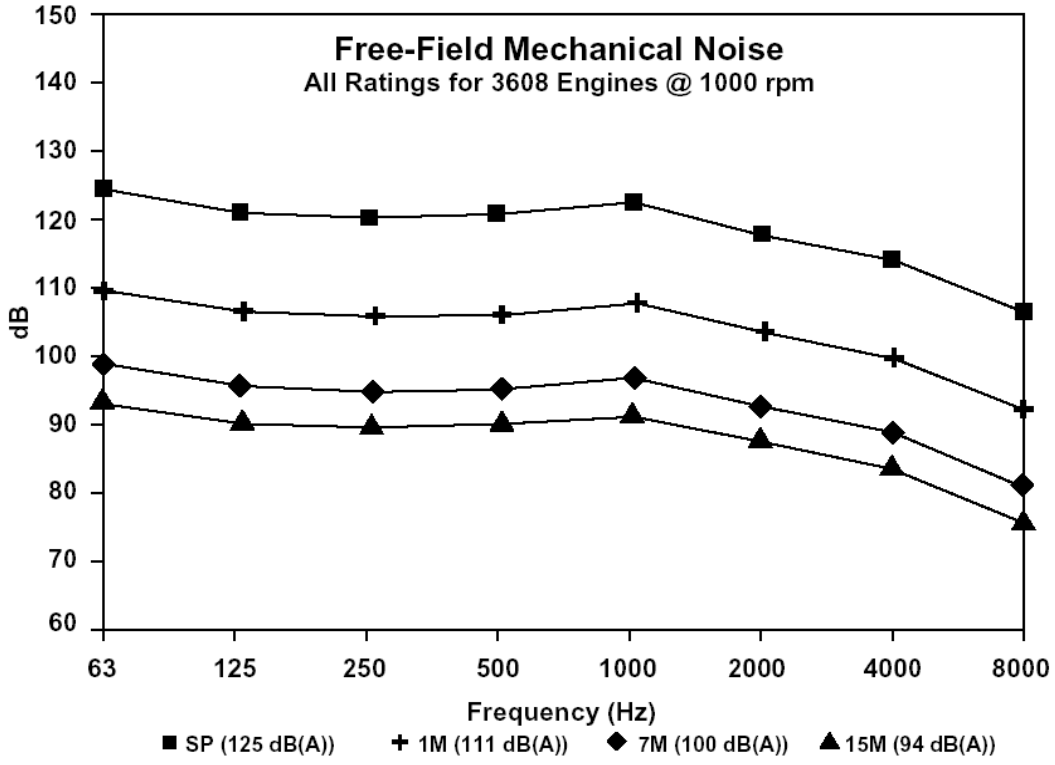


Figure 16



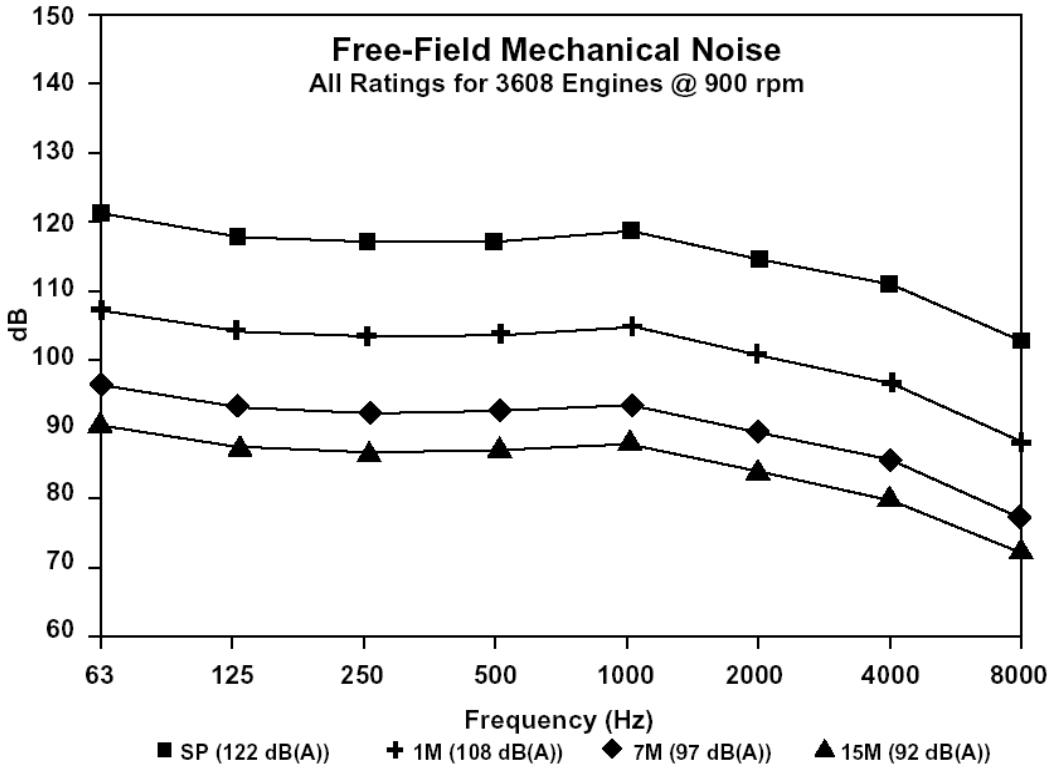
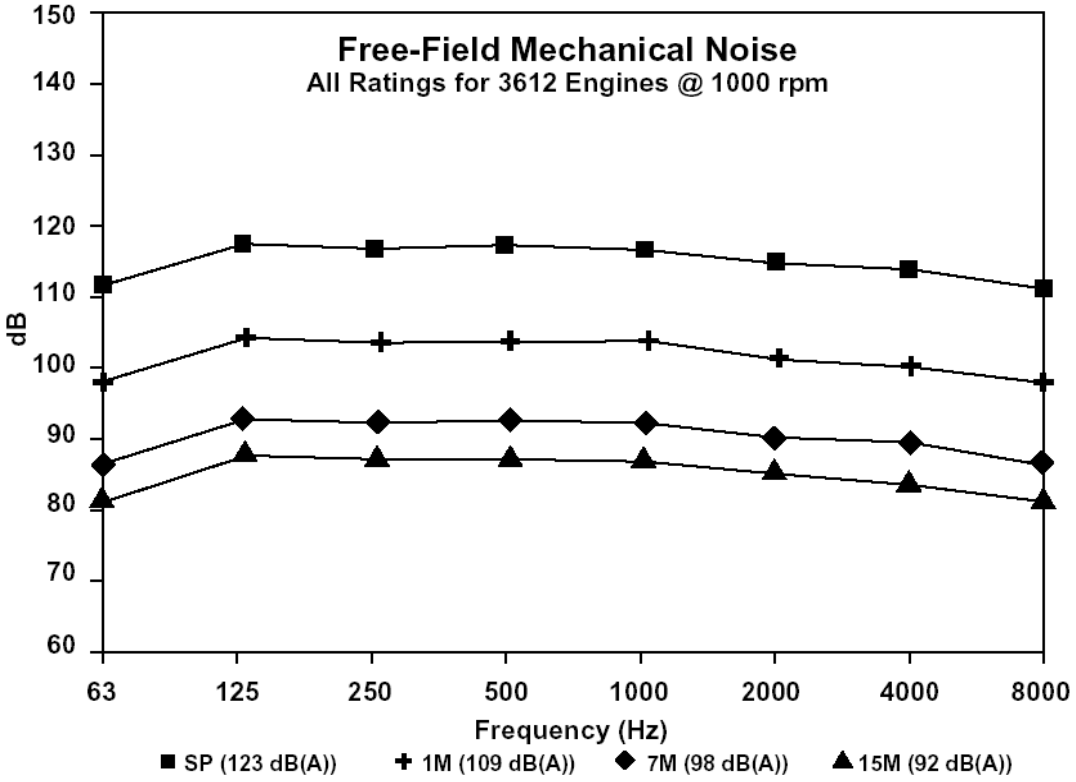


Figure 17



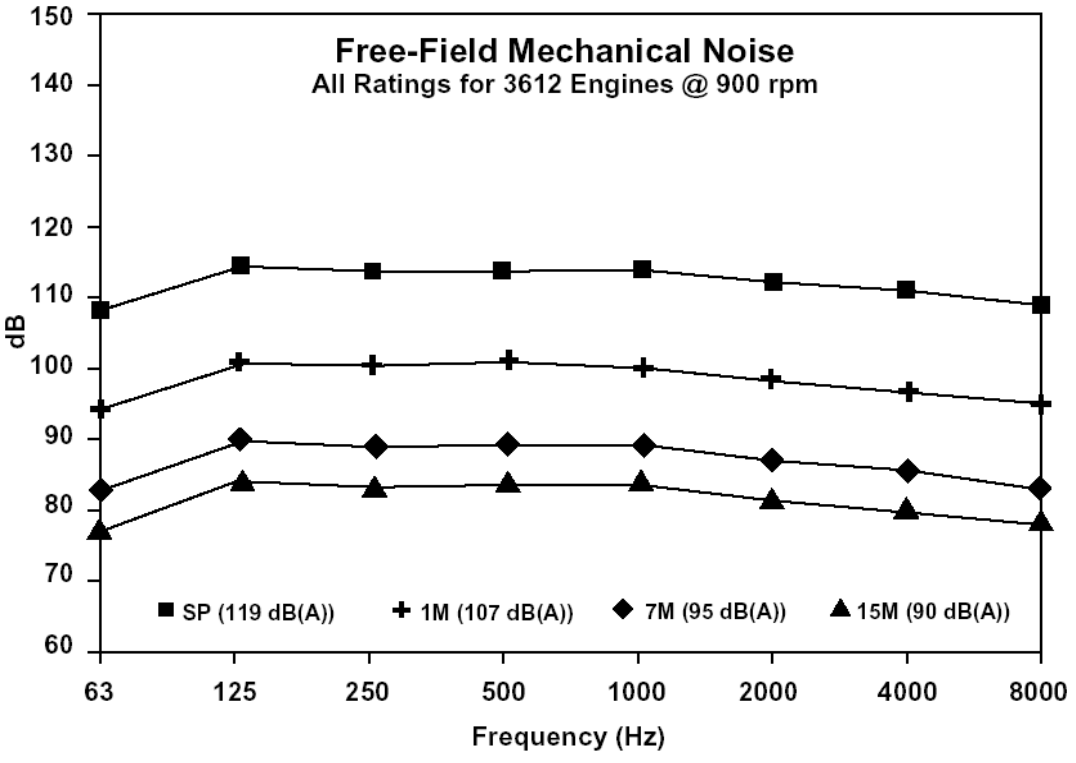
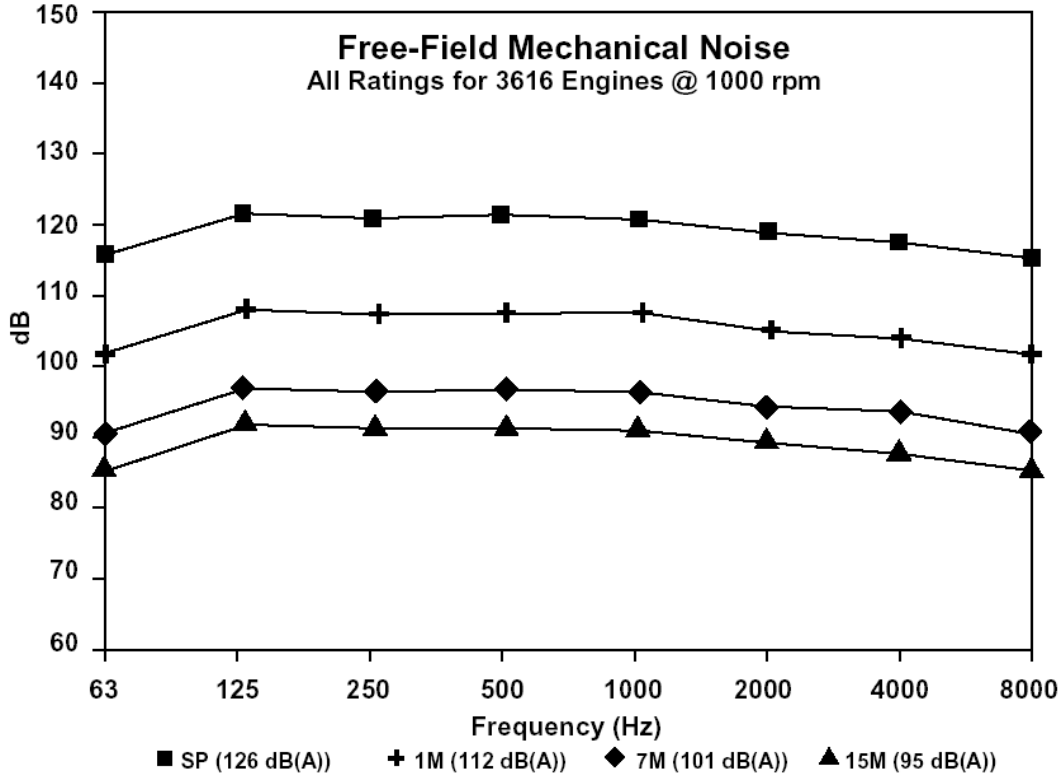


Figure 18



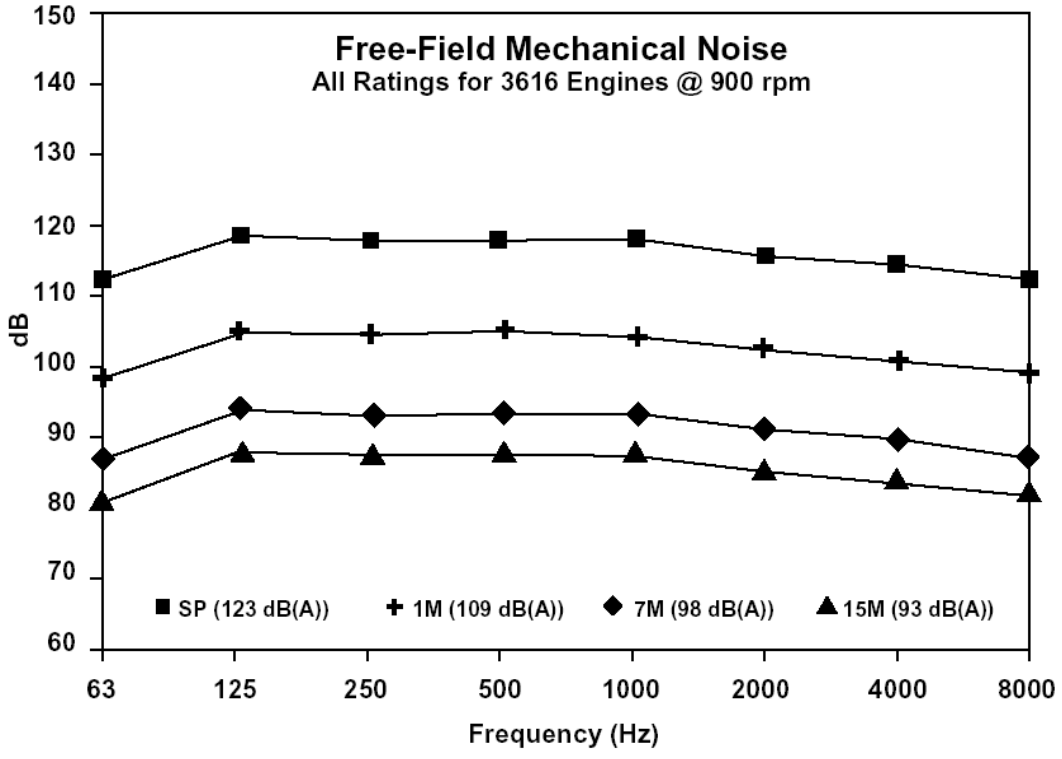
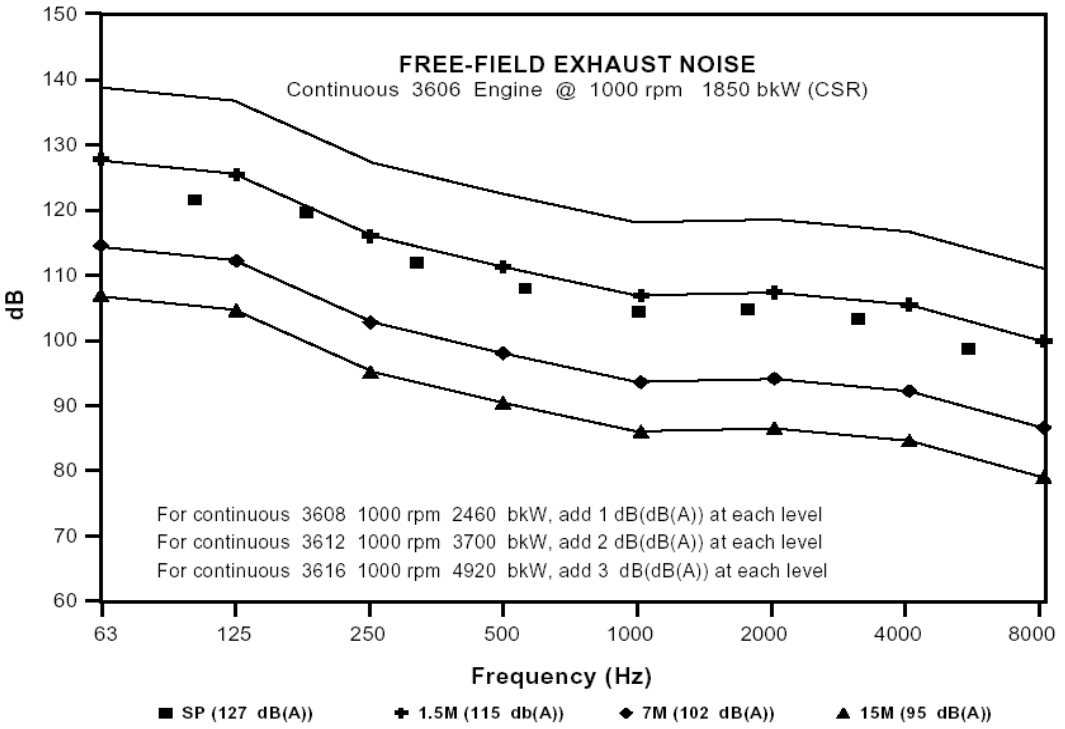


Figure 19

Free-Field Exhaust Noise



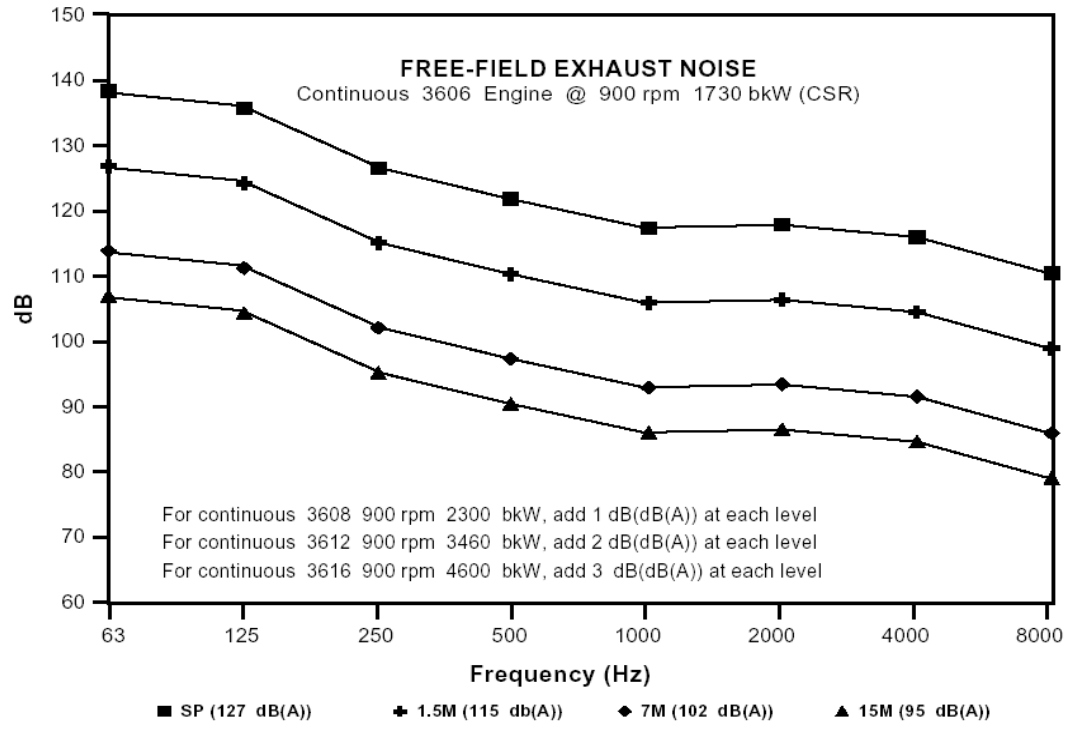
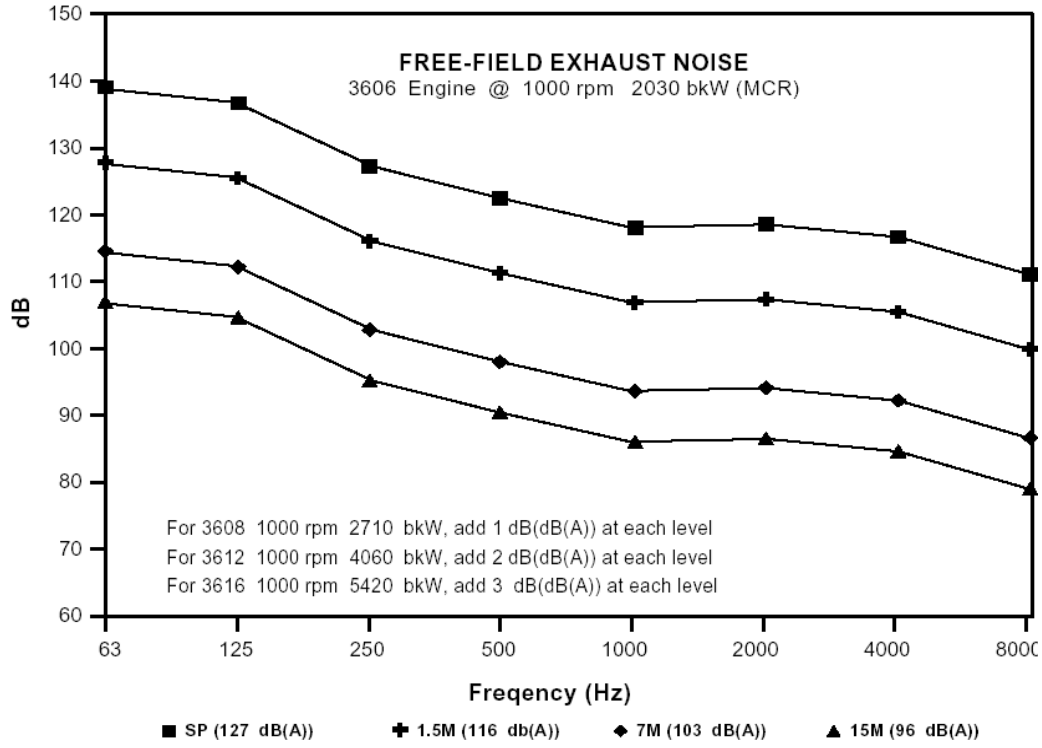


Figure 20



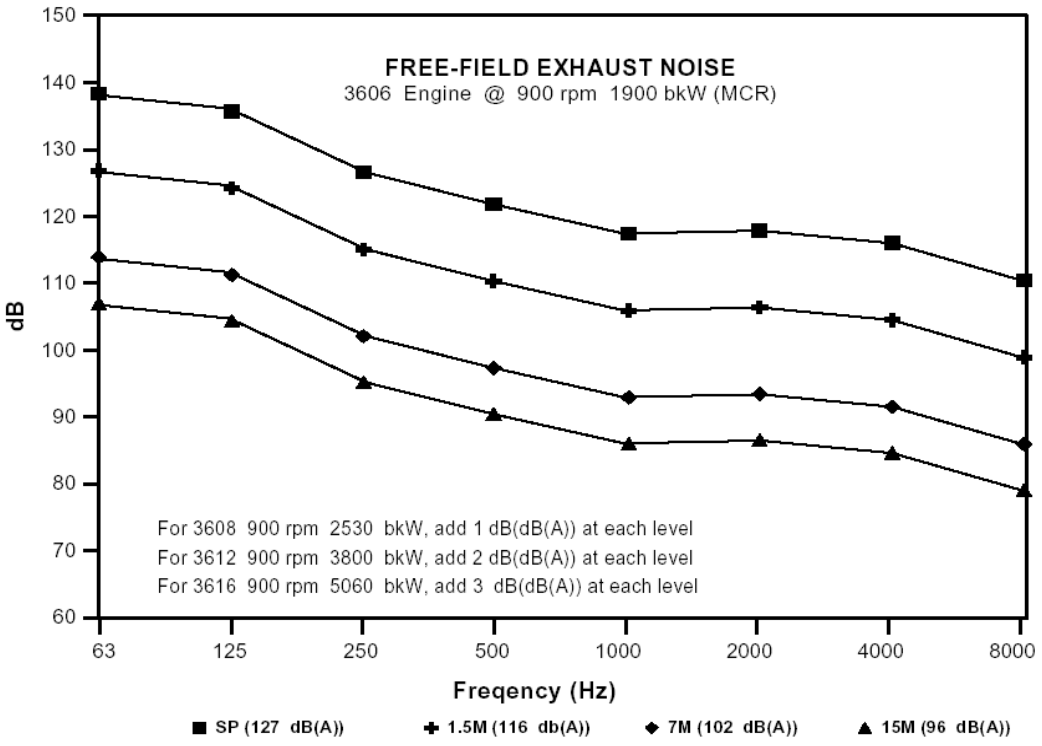


Figure 21

Reference Material

The following information is provided as additional reference to subjects discussed in this guide.

LEBW4976
Application and Installation Guide, “Diesel Fuels and Diesel Fuel Systems”

LEBW4985
Application and Installation Guide, “Diesel Engine Commissioning - 3600/C280”

SEBU6965
Operation and Maintenance Manual “3600 Distillate Fuel Engines”

SEBU7003
Operation and Maintenance Manual, “Cat 3600 Series and C280 Series Diesel Engine Fluids Recommendations”

SENR3599
Systems Operation/ Testing and Adjusting, “3606 and 3608 Engines”

SENR3593
Systems Operation/ Testing and Adjusting, “3612 and 3616 Engines”

RENR5083
Systems Operation/ Testing and Adjusting, “C280 Marine Engines”

SENR3598
Specifications, “3606 and 3608 Engines”

SENR3592
Specifications, “3612 and 3616 Engines”

RENR5082
Specifications, “C280 Marine Engines”

SEBD9307
Engine News, “New Specification For The Minimum Fuel Pressure At The Inlet To The Fuel Transfer Pump”

LEBW5337-01

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