G3500J / G3516TA Engines

Technical Information

Application & Installation Guide

LEBW0057-01

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1 Introduction

This Technical Information Guide provides information regarding Cat® G3500J and G3516TA engines. This information is supplemental to the information presented in the Cat Technical Marketing Information (TMI) database. At the time of publishing, this data is correct; updates will be included periodically and republished. Dealers and customers may use TMI or Gas Engine Rating Pro (GERP) for additional information.

The G3516TA referenced in this guide are engines with the AL7 serial number prefix.

1.1 References

The following information is provided as an additional reference to subjects discussed in this guide. Please note the information in these publications is subject to change without notice.

- SEHS9031 - Storage Procedure for Cat Products
- M0065664 - Systems Operation, Testing and Adjusting (G3500J Engines)
- M0080757 - Systems Operation, Testing and Adjusting (G3516 TA Engines)
- RENR2270 - Troubleshooting (G3500J Engines)
- M0080340 - Troubleshooting (G3516 TA Engines)
- SEBU9429 - Operation and Maintenance Manual (G3500J)
- SEBU9297 - Operation and Maintenance Manual (G3516 TA Engines)
- UENR7140 - Schematic (G3500J)
- UENR2167 - Schematic (G3516 TA)

1.2 Changes since last revision

- Updated entire guide to current format
- Section 2: Added G3516J and G3520J Uprate ratings

2 General Data

Figure 2.1 **Basic Engine Configuration – G3500J/G3516TA**

System Description		G3500J	G3516TA
Cylinder bore	mm (in)	170 mm (6.7 in)	170 mm (6.7 in)
Stroke	mm (in)	190 mm (7.5 in)	190 mm (7.5 in)
Displacement per cylinder	L (in^3)	4.3 L (263 in^3)	4.3 L (263 in^3)
Low idle speed	rpm	700	700
Combustion		lean burn	rich burn
Crank radius	mm (in)	95 (3.74)	95 (3.74)
Connecting rod length	mm (in)	380 (14.96)	380 (14.96)

Figure 2.2 **Engine Ratings – G3500J/G3516TA**

Engine Model	Power @ Rated Speed bkW (bhp)	Compression Ratio	Operating Speed Range rpm	AC Temp °C (°F)	NO_x mg/Nm^3 (g/bhp-hr)
G3520J	1104 (1480) at 1200 rpm	8:1	1200-900	54 (130)	250 (0.5)
	1253 (1680) at 1200 rpm	8:1	1200-900	54 (130)	250 (0.5)
	1286 (1725) at 1400 rpm	8:1	1400-900	54 (130)	250 (0.5)
G3516J	1029 (1380) at 1400 rpm	8:1	1400-1050	54 (130)	150 or 250 (0.3 or 0.5)
	1118 (1500) at 1400 rpm	8:1	1400-1050	54 (130)	150 or 250 (0.3 or 0.5)
G3516TA	1029 (1380) at 1400 rpm	8.5:1	1400-1050	54 (130)	***
G3512J	772 (1035) at 1400 rpm	8:1	1400-1050	54 (130)	250 (0.5)
G3508J	515 (690) at 1400 rpm	8:1	1400-900	54 (130)	250 (0.5)

*** stoichiometric combustion; for engine-out emissions see rating data sheet

Figure 2.3 **Engine weight (basic engine feature only)**

		G3508J	G3512J	G3516J	G3520J	G3516TA
Wet weight	kg (lb)	6048 (13,306)	7081 (15,611)	9189 (20,259)	10 785 (23,776)	9232 (20,352)
Dry weight	kg (lb)			9008 (19,859)	9257 (20,409)	7924 (17,470)

3 Combustion Air System

Figure 3.1 **Air system technical details**

		G3508J	G3512J	G3516J	G3520J	G3516TA
High inlet air temperature (low load), warning/shutdown	°C (°F)	69/85 (156/185)	69/85 (156/185)	69/85 (156/185)	69/85 (156/185)	86/90 (187/194)
Air inlet restriction new/maximum	°C (°F)	125/380 (5/15)	125/380 (5/15)	125/380 (5/15)	125/380 (5/15)	125/380 (5/15)

4 Exhaust Gas System

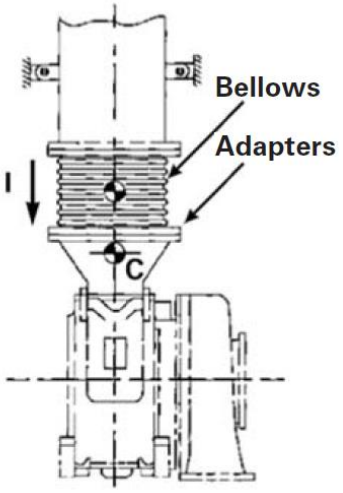
Figure 4.1 **Exhaust system technical details**

		G3508J	G3512J	G3516J	G3520J	G3516TA
Exhaust system backpressure, maximum	mm H_2O (in H_2O)	686 (27)	686 (27)	686 (27)	686 (27)	686 (27)
Exhaust outlet connection ID	mm (in)	270 (10.6)	270 (10.6)	270 (10.6)	270 (10.6)	203 (8)
Minimum exhaust temperature into TWC	°C (°F)	---	---	---	---	400 (752)
Vertical force on turbocharger outlet, maximum	N (lb_f)	178 (40)	178 (40)	178 (40)	178 (40)	178 (40)
Moment on turbocharger outlet, maximum	N (lb_f)	120 (88.5)	120 (88.5)	120 (88.5)	120 (88.5)	120 (88.5)

4.1 Calculation of loading on turbocharger exhaust

Vertical exhaust: C = adapter weight, I = 1/2 bellows weight

With Cat hardware: C = 28 N (6.4 lb), I = 6 N (1.4 lb)



Sum of Vertical Forces

$Fv = C + I = 28 + 6 = 34$ N (7.8 lb)

Sum of Moments

$M = (h_1) \times C + (h_2) \times I = (0 \times 28) + (0 \times 6) = 0$ N·m (ft-lb)

Since Fv < 178 N (40 lb) and M < 120 N·m (88.5 ft-lb), the exhaust system meets the load and moment requirements.

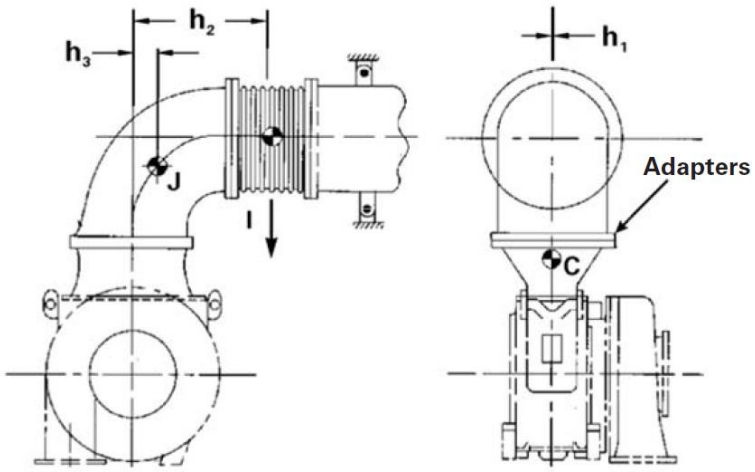
Horizontal Exhaust: C = Adapter Weight, I = 1/2 Bellows Weight, J = Elbow Adapter

With Cat Hardware: C = 28 N (6.4 lb), I = 6 N (1.4 lb), J = 47 N (10.7 lb)

h_1 = 0

h_2 = 100 mm (3.9 in)

h_3 = 580 mm (22.8 in)



Sum of Vertical Forces

$Fv = C + I + J = 28 + 6 + 47 = 81$ N (18.5 lb)

Sum of Moments

$M = (h_1) \times C + (h_2) \times I + (h_3) \times J = (0 \times 28) + (0.100 \times 6) + (0.580 \times 47)$
$= 27.9$ N·m (20.8 ft-lb)

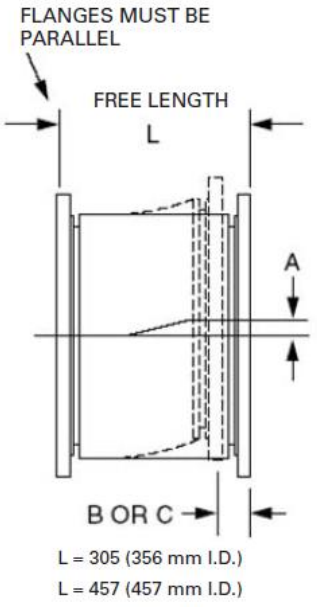
Since Fv < 178 N (40 lb) and M < 120 N·m (88.5 ft-lb), the exhaust system meets the load and moment requirements.

4.2 Operational limitations of bellows

Figure 4.2 **Installation limits of bellows exhaust fittings**

hose diameter		A maximum offset between flanges	B maximum compression from free length	C maximum compression from free length
203.2 mm (8 in)	mm (in)	19.05 (0.75)	38.1 (1.5)	25.4 (1.0)
254.0 mm (10 in)	mm (in)	19.05 (0.75)	38.1 (1.5)	25.4 (1.0)
304.8 mm (12 in)	mm (in)	19.05 (0.75)	38.1 (1.5)	25.4 (1.0)
355.6 mm (14 in)	mm (in)	19.05 (0.75)	76.2 (3.0)	25.4 (1.0)

diameter		spring rate for bellows
203.2 mm (8 in)	kN/m (lb/in)	29.7 (170)
254.0 mm (10 in)	kN/m (lb/in)	---
304.8 mm (12 in)	kN/m (lb/in)	33.9 (194)
355.6 mm (14 in)	kN/m (lb/in)	68.5 (391)



EXHAUST SYSTEM

5 Fuel System

Figure 5.1 **Fuel system technical details**

		G3508J	G3512J	G3516J	G3520J	G3516TA
Fuel supply pressure, minimum/maximum	kPag (psig)	48/276 (7/40)	48/276 (7/40)	48/276 (7/40)	48/276 (7/40)	221/241 (32/35)

Figure 5.2 **GSOV operating pressure ratings**

		489-1434
nominal	kPa (psi)	689 (100)
maximum	kPa (psi)	689 (100)
proof	kPa (psi)	1034 (150)
burst	kPa (psi)	3450 (500)

6 Lubricating Oil System

Figure 6.1 **Lubricating system technical details**

		G3508J	G3512J	G3516J	G3520J	G3516TA
Minimum oil pressure, (shutdown, high idle)	kPa (psi)	276 (40)	276 (40)	276 (40)	1200rpm 172(25) 1400rpm 242(35)	287 (42)
Minimum oil pressure, (shutdown, low idle)	kPa (psi)	103 (15)	103 (15)	103 (15)	103 (15)	150 (22)
High engine oil temperature (warning)	°C (°F)	102 (215)	102 (215)	102 (215)	102 (215)	102 (215)
High engine oil temperature (shutdown)	°C (°F)	104 (220)	104 (220)	104 (220)	104 (220)	104 (220)
Prelube pump capacity, intermittent (pneumatic)	L/min (gal/min)	76 (20)	76 (20)	76 (20)	N/A	76 (20)
Prelube pump capacity, intermittent (electric)	L/min (gal/min)	49 (13)	49 (13)	49 (13)	N/A	49 (13)
Prelube pump capacity, continuous (electric)	L/min (gal/min)	3.8 (1)	3.8 (1)	3.8 (1)	3.8 (1)	3.8 (1)
Oil sump capacity	L (gal)	230.9 (61)	336.9 (89)	423.9 (112)	541.3 (143)	423.9 (112)
BSOC @ 100% load, typical	g/bkW-hr (lb/bhp-hr)	0.426 (0.0007)	0.426 (0.0007)	0.426 (0.0007)	0.426 (0.0007)	0.426 (0.0007)
High oil filter differential pressure (warning)	kPa (psi)	103 (15)	103 (15)	103 (15)	103 (15)	220 (32)
High oil filter differential pressure (shutdown)	kPa (psi)	138 (20)	138 (20)	138 (20)	138 (20)	240 (35)
Low oil filter differential pressure (warning)	kPa (psi)	35 (5)	35 (5)	35 (5)	35 (5)	5 (1)
Low oil filter differential pressure (shutdown)	kPa (psi)	7 (1)	7 (1)	7 (1)	7 (1)	0 (0)
Main oil pump flow rate	L/min (gal/min)			220 (58)	410 (108)	220 (58)

Figure 6.2 **Prelube solenoid valve pressure ratings**

		9Y-6673	430-9948
Nominal	kPa (psi)	1034 (150)	1034 (150)
Maximum	kPa (psi)	1724 (250)	1034 (150)
Proof	kPa (psi)	8618 (1250)	5171 (750)
Burst	kPa (psi)	N/A	N/A

Figure 6.3 **TDI T303 turbine motor performance**

Inlet pressure psig	Flow (methane gas) SCFM	Flow (compressed air) SCFM
150	365	300
120	300	239
90	235	185
60	165	130

7 Cooling System

Figure 7.1 **Cooling system – high temperature circuit (JW)**

		G3508J	G3512J	G3516J	G3520J	G3516TA
Cooling circuit configuration		JW+OC+AC1	JW+OC+AC1	JW+OC+AC1	JW+OC+AC1	JW+AC1
Circuit coolant volume (engine only)	L (gal)	114 (30)	148 (39)	205 (54)	270 (71)	178 (48)
High coolant temperature (warning)	°C (°F)	113 (235)	113 (235)	113 (235)	113 (235)	113 (235)
High coolant temperature (shutdown)	°C (°F)	117 (243)	117 (243)	117 (243)	117 (243)	117 (243)
Low coolant temperature (warning)	°C (°F)	5 (41)	5 (41)	5 (41)	5 (41)	60 (140)

Figure 7.2 **Cooling system – low temperature circuit (SCAC)**

		G3508J	G3512J	G3516J	G3520J	G3516TA
Cooling circuit configuration		AC2	AC2	AC2	AC2	OC+AC2
Circuit coolant volume (engine only)	L (gal)	13 (3.5)	15 (3.9)	16.5 (4.3)	17.5 (4.6)	29.8 (7.9)

Figure 7.3 **Fuel heater heat rejection**

		G3508J	G3512J	G3516J	G3520J	G3516TA
Heat rejection @ 100% load	kW (Btu/min)			–0.90 (–59)	–1.13 (-64)	N/A
Heat rejection @ 75% load	kW (Btu/min)			–0.81 (–46)	–1.02 (–58)	N/A
Heat rejection @ 50% load	kW (Btu/min)			–0.67 (–38)	–0.83 (–47)	N/A

Figure 7.4 **Cooling system temperature limits**

		G3500J / G3516TA
Oil cooler inlet temperature maximum	°C (°F)	82 (180)

Figure 7.5 **Cooling system pressure limits**

		G3500J / G3516TA
Aftercooler core operating pressure range	kPa (psi)	248-276 (36-40)
Engine block operating pressure range	kPa (psi)	248-276 (36-40)
Maximum static head, pump inlet	kPa (psi)	196 (24.7)
Maximum static head, engine outlet	kPa (psi)	196 (24.7)
Maximum water pump head pressure	kPa (psi)	0

Note: Higher engine block operating pressures may be possible with a customer provided pump.

Figure 7.6 **Radiator cap pressure settings**

	JW temp		G3500J / G3516TA
Maximum cap pressure, standard JW system	88-99°C (190-210°F)	kPa (psi)	28-48 (4-7)
Maximum cap pressure, standard JW system	110°C (230°F)	kPa (psi)	131-151 (19-22)
Maximum cap pressure, standard JW system	127°C (260°F)	kPa (psi)	196 (28.5)

8 Starting System

Figure 9.1 **G3500J/G3516TA breakaway and cranking torques**

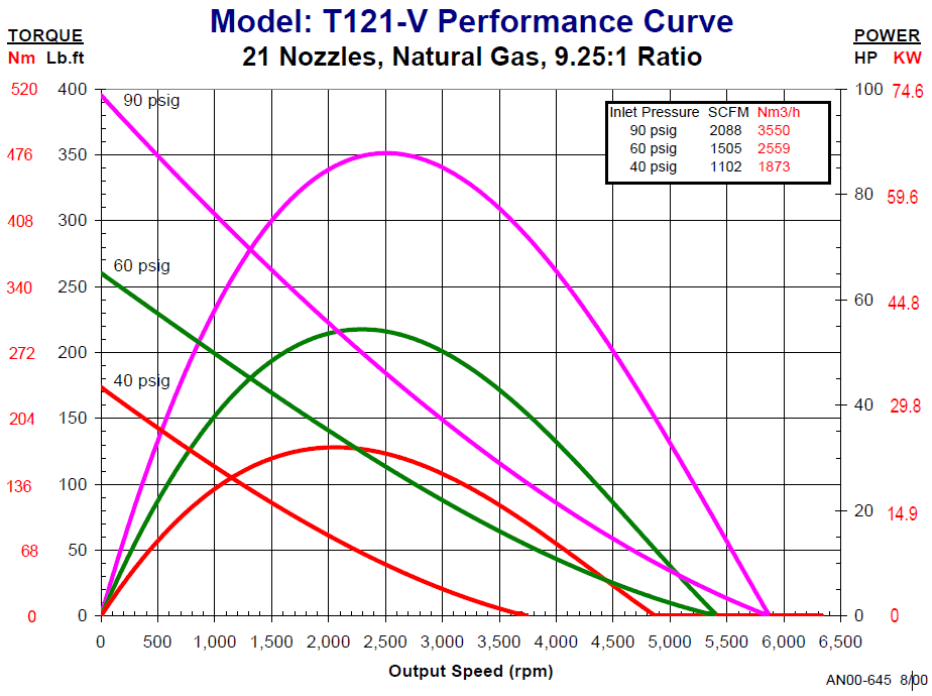
		G3508J	G3512J	G3516J	G3520J	G3516TA
Breakaway torque	N-m (ft-lb)	1016 (750)	1247 (920)	1545 (1140)	1912 (1410)	1545 (1140)
Cranking torque 0°C (32°F) with SAE 30 wt oil	N-m (ft-lb)	1085 (800)	1573 (1160)	1898 (1400)	2165 (1597)	1898 (1400)
Cranking torque 10°C (50°F) with SAE 30 wt oil	N-m (ft-lb)	854 (630)	1037 (765)	1288 (950)	1607 (1185)	1288 (950)
Minimum engine cranking speed	rpm	150	150	150	150	100

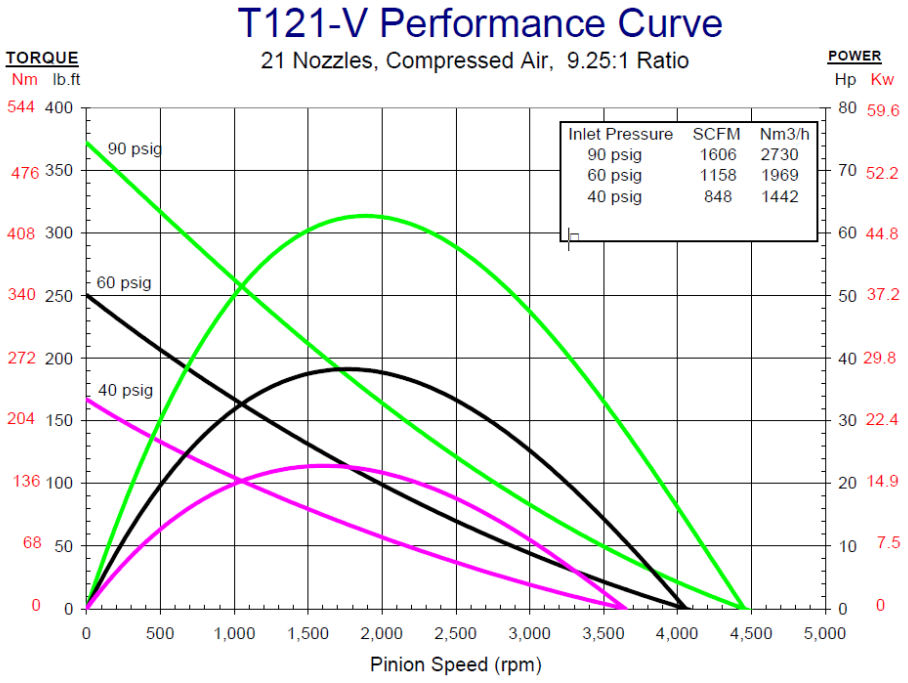
Figure 9.2 **Starter solenoid valve pressure ratings**

		430-9948
Nominal	kPa (psi)	1034 (150)
Maximum	kPa (psi)	1034 (150)
Proof	kPa (psi)	5171 (750)
Burst	kPa (psi)	N/A

Starter performance – TDI model T121-V turbine starter (90 psig, one per engine)

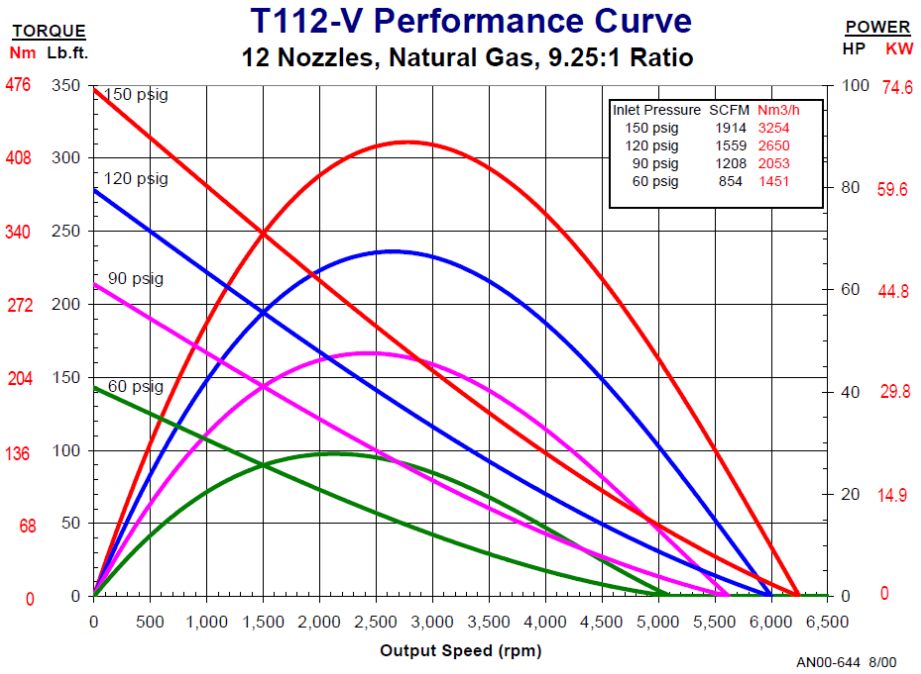
Starter pinion = 12 teeth, G3500 flywheel = 183 teeth

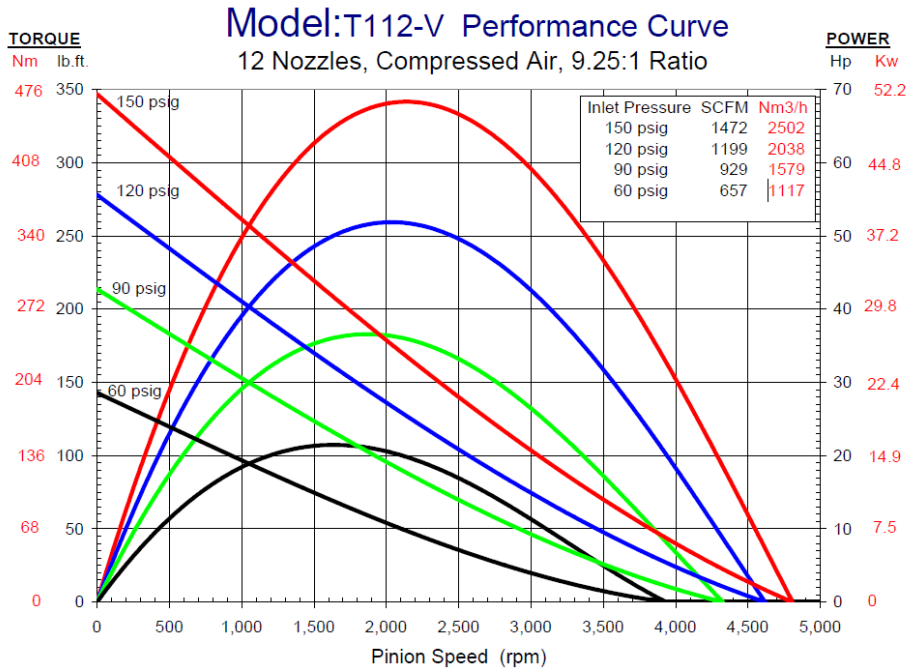




Starter performance – TDI model T112-V turbine starter (150 psig, one per engine)

Starter pinion = 12 teeth, G3500 flywheel = 183 teeth





STARTING SYSTEM

9 Physical data – alignment, mounting, & dynamic analysis

9.1 Torsional Vibration Analysis (TVA) information

Basic engine information for a TVA (mass-elastic details, inertias, etc.) may be found in the Cat Technical Marketing Information (TMI) database. Your Cat dealer has access to this.

Cat TVA Sign Convention

Engines are usually viewed from the rear, at which point the crankshaft is rotating counter clockwise (CCW). This view creates a leading sign convention, whereas most mathematical systems work with lagging sign convention. Therefore, the signs (+ve or –ve) for imaginary component of tangential pressures based on the sign convention of the Cat TVA will be different from most of the commercial FFT programs. TVAs completed by outside vendors should review this sign convention before using the values provided by Cat.

9.2 Unbalanced forces and moments

Cat engines are balanced by design and do not exhibit or produce significant primary or secondary unbalanced forces or moments. These values represent Caterpillar® estimates of the forces and moments due to manufacturing tolerances. An unbalanced assembly produces both primary and secondary forces and moments that are possible in both the horizontal and vertical directions. These values can be considered significant at the B90 level, meaning approximately 90% of examples of these engine models will produce lower force and moment levels.

Figure 8.1 **G3516J/G3516TA unbalanced forces & moments data**

order	force (N)		moment (N-m)	
	vertical	horizontal	pitch	yaw
1.0	1554.9	1076.4	910.2	634.5
2.0	349.7	276.2	211.0	163.0
4.0	774.1	770.8	47.7	18.3

Figure 8.2 **G3520J unbalanced forces & moments data**

order	force (N)		moment (N-m)	
	vertical	horizontal	pitch	yaw
1.0	1740.6	1200.4	1289.9	899.0
2.0	392.7	309.1	297.7	231.0
4.0	11.2	8.8	8.4	6.6

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