G3512

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1800	RATING STRATEGY:	EMERGENCY
COMPRESSION RATIO:	9.7	PACKAGE TYPE:	WITH RADIATOR
AFTERCOOLER TYPE:	SCAC	RATING LEVEL:	STANDBY
AFTERCOOLER - STAGE 2 INLET (°F):	130	FUEL:	NATURAL GAS
AFTERCOOLER - STAGE 1 INLET (°F):	198	FUEL SYSTEM:	CAT LOW PRESSURE WITH AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (°F):	210	FUEL PRESSURE RANGE(psig): (See note 1)	0.5-5.0
ASPIRATION:	TA	FUEL METHANE NUMBER:	85
COOLING SYSTEM:	JW+OC+1AC, 2AC	FUEL LHV (Btu/scf):	905
CONTROL SYSTEM:	ADEM4 W/ IM	ALTITUDE CAPABILITY AT 77°F INLET AIR TEMP. (ft):	9390
EXHAUST MANIFOLD:	DRY	POWER FACTOR:	0.8
COMBUSTION:	LOW EMISSION	VOLTAGE(V):	440-4160
FAN POWER (bhp):	50		

RATING		NOTES	LOAD	100%	75%	50%
PACKAGE POWER	(WITH FAN)	2,3	ekW	750	563	375
PACKAGE POWER	(WITH FAN)	2,3	kVA	938	703	469
ENGINE POWER	(WITHOUT FAN)	3	bhp	1114	853	595
GENERATOR EFFICIENCY		2	%	94.5	93.9	92.2
PACKAGE EFFICIENCY(@ 1.0 Power Factor)	(ISO 3046/1)	4	%	33.8	31.7	28.0
THERMAL EFFICIENCY		5	%	49.4	50.3	51.8
TOTAL EFFICIENCY (@ 1.0 Power Factor)		6	%	83.2	82.0	79.8

ENGINE DATA						
PACKAGE FUEL CONSUMPTION	(ISO 3046/1)	7	Btu/ekW-hr	10282	10994	12495
PACKAGE FUEL CONSUMPTION	(NOMINAL)	7	Btu/ekW-hr	10481	11208	12738
ENGINE FUEL CONSUMPTION	(NOMINAL)	7	Btu/bhp-hr	7057	7391	8028
AIR FLOW (77°F, 14.7 psia)	(WET)	8, 9	ft3/min	2451	1950	1456
AIR FLOW	(WET)	8, 9	lb/hr	10868	8647	6454
FUEL FLOW (60ºF, 14.7 psia)			scfm	145	116	88
COMPRESSOR OUT PRESSURE			in Hg(abs)	70.9	63.6	55.5
COMPRESSOR OUT TEMPERATURE			°F	281	232	183
AFTERCOOLER AIR OUT TEMPERATURE			°F	134	133	133
INLET MAN. PRESSURE		10	in Hg(abs)	64.3	51.7	39.1
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	11	°F	134	133	133
TIMING			°BTDC	32	32	32
EXHAUST TEMPERATURE - ENGINE OUTLET		12	°F	953	953	949
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	13, 9	ft3/min	6955	5533	4123
EXHAUST GAS MASS FLOW	(WET)	13, 9	lb/hr	11263	8964	6694

REGULATORY INFORMATION							
AGENCY	TIER/STAGE	REGULATION	LOCALITY		MAX LIMITS	YEAR IN	YEAR OUT
EPA		S.I. STATIONARY NON-EMERGENCY - NATURAL GAS	U.S. (EXCL CALIF)	14	g/bhp-hr - NOx: 1.0 CO: 2.0 VOC: 0.7	2011	----

ENERGY BALANCE DATA						
LHV INPUT		15	Btu/min	131017	105073	79613
HEAT REJECTION TO JACKET WATER (JW)		16,24	Btu/min	20683	18584	16441
HEAT REJECTION TO ATMOSPHERE	(INCLUDES GENERATOR)	17	Btu/min	7840	6945	6342
HEAT REJECTION TO LUBE OIL (OC)		18,24	Btu/min	4158	3729	3216
HEAT REJECTION TO EXHAUST (LHV TO 77°F)		19,20	Btu/min	45621	36432	27244
HEAT REJECTION TO EXHAUST (LHV TO 248°F)		19	Btu/min	35672	28377	21092
HEAT REJECTION TO A/C - STAGE 1 (1AC)		21,24	Btu/min	3086	1175	-458
HEAT REJECTION TO A/C - STAGE 2 (2AC)		22,25	Btu/min	3901	3145	2428
PUMP POWER		23	Btu/min	971	971	971

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1. (Standard reference conditions of 77°F, 29.60 in Hg barometric pressure.) No overload permitted at rating shown. Consult the altitude deration factor chart for applications that exceed the rated altitude or temperature.

Emission levels are at engine exhaust flange prior to any after treatment. Values are based on engine operating at steady state conditions, adjusted to the specified NOx level at 100% load. Tolerances specified are dependent upon fuel quality. Fuel methane number cannot vary more than ±3.

For notes information consult page three.

FUEL USAGE GUIDE

CAT METHANE NUMBER	65	<70	70	75	80	85	100
DERATION FACTOR	0	0	1	1	1	1	1

ALTITUDE DERATION FACTORS AT RATED SPEED

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating
120	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating
110	1	1	1	0.94	0.86	0.78	0.71	0.64	0.57	0.51	No Rating	No Rating	No Rating
100	1	1	1	1	1	1	1	0.99	0.90	0.81	0.72	0.63	0.54
90	1	1	1	1	1	1	1	1	1	0.91	0.81	0.72	0.62
80	1	1	1	1	1	1	1	1	1	1	0.90	0.80	0.70
70	1	1	1	1	1	1	1	1	1	1	1	0.90	0.78
60	1	1	1	1	1	1	1	1	1	1	1	1	0.88
50	1	1	1	1	1	1	1	1	1	1	1	1	0.94

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating
120	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating	No Rating
110	1.27	1.34	1.41	1.49	1.56	1.63	1.71	1.79	1.86	1.95	No Rating	No Rating	No Rating
100	1.18	1.25	1.32	1.39	1.46	1.53	1.61	1.68	1.76	1.84	1.87	1.87	1.87
90	1.09	1.16	1.22	1.29	1.36	1.43	1.51	1.58	1.66	1.74	1.77	1.77	1.77
80	1	1.06	1.13	1.19	1.26	1.33	1.41	1.48	1.55	1.63	1.66	1.66	1.66
70	1	1	1.03	1.10	1.17	1.23	1.31	1.38	1.45	1.53	1.56	1.56	1.56
60	1	1	1	1	1.07	1.14	1.20	1.28	1.35	1.42	1.45	1.45	1.45
50	1	1	1	1	1	1.04	1.10	1.17	1.24	1.32	1.34	1.34	1.34

ALTITUDE (FEET ABOVE SEA LEVEL)

FUEL USAGE GUIDE:
This table shows the derate factor required for a given fuel. Note that deration occurs as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar methane number calculation.

ALTITUDE DERATION FACTORS:
This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site. The derate factors shown assume a specific air-to-core temperature rise and zero additional air flow restriction on the standard packaged radiator. Refer to TMI Systems Data for fan air flow and air-to-core temperature rise values. Increased fan airflow restriction or a different air-to-core rise value requires a Special Rating Request to determine actual engine power at your site. Additional rating may be available with a larger, custom radiator.

ACTUAL ENGINE RATING:
To determine the actual rating of the engine at site conditions, one must consider separately, limitations due to fuel characteristics and air system limitations. The Fuel Usage Guide deration establishes fuel limitations. The Altitude/Temperature deration factors and RPC (reference the Caterpillar Methane Program) establish air system limitations. RPC comes into play when the Altitude/Temperature deration is less than 1.0 (100%). Under this condition, add the two factors together. When the site conditions do not require an Altitude/Temperature derate (factor is 1.0), it is assumed the turbocharger has sufficient capability to overcome the low fuel relative power, and RPC is ignored. To determine the actual power available, take the lowest rating between 1) and 2).
1) Fuel Usage Guide Deration
2) 1-((1-Altitude/Temperature Deration) + (1-RPC))

AFTERCOOLER HEAT REJECTION FACTORS(ACHRF):
To maintain a constant air inlet manifold temperature, as the inlet air temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor (ACHRF) to adjust for inlet air temp and altitude conditions. See notes 24 and 25 for application of this factor in calculating the heat exchanger sizing criteria. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail.

NOTES:
1. Fuel pressure range specified is to the engine fuel control valve. Additional fuel train components should be considered in pressure and flow calculations.
2. Generator efficiencies, power factor, and voltage are based on standard generator. [Package Power (ekW) is calculated as: (Engine Power (bkW) - Fan Power (bkW)) x Generator Efficiency], [Package Power (kVA) is calculated as: (Engine Power (bkW) - Fan Power (bkw)) x Generator Efficiency / Power Factor]
3. Rating is with two engine driven water pumps. Tolerance is (+)3, (-)0% of full load.
4. Package Efficiency published in accordance with ISO 3046/1, based on a 1.0 power factor.
5. Thermal Efficiency is calculated based on energy recovery from the jacket water, lube oil, 1st stage aftercooler, and exhaust to 248ºF with engine operation at ISO 3046/1 Package Efficiency, and assumes unburned fuel is converted in an oxidation catalyst.
6. Total efficiency is calculated as: Package Efficiency + Thermal Efficiency. Tolerance is ±10% of full load data.
7. ISO 3046/1 Package fuel consumption tolerance is (+)5, (-)0% at the specified power factor. Nominal package and engine fuel consumption tolerance is ± 3.0% of full load data at the specified power factor.
8. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.
9. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.
10. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.
11. Inlet manifold temperature is a nominal value with a tolerance of ± 9°F.
12. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.
13. Exhaust flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 6 %.
14. Gaseous emissions data measurements are consistent with those described in EPA 40 CFR PART 60 SUBPART JJJJ and ISO 8178 for measuring VOC, CO, and NOx. Gaseous emissions values are weighted cycle averages and are in compliance with the stationary regulations.
15. LHV rate tolerance is ± 3.0%.
16. Heat rejection to jacket water value displayed includes heat to jacket water alone. Value is based on treated water. Tolerance is ± 10% of full load data.
17. Heat rejection to atmosphere based on treated water. Tolerance is ± 50% of full load data.
18. Lube oil heat rate based on treated water. Tolerance is ± 20% of full load data.
19. Exhaust heat rate based on treated water. Tolerance is ± 10% of full load data.
20. Heat rejection to exhaust (LHV to 77°F) value shown includes unburned fuel and is not intended to be used for sizing or recovery calculations.
21. Heat rejection to A/C - Stage 1 based on treated water. Tolerance is ±5% of full load data.
22. Heat rejection to A/C - Stage 2 based on treated water. Tolerance is ±5% of full load data.
23. Pump power includes engine driven jacket water and aftercooler water pumps. Engine brake power includes effects of pump power.
24. Total Jacket Water Circuit heat rejection is calculated as: (JW x 1.1) + (OC x 1.2) + (1AC x 1.05) + [0.78 x (1AC + 2AC) x (ACHRF - 1) x 1.05]. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.
25. Total Second Stage Aftercooler Circuit heat rejection is calculated as: (2AC x 1.05) + [(1AC + 2AC) x 0.22 x (ACHRF - 1) x 1.05]. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.

FREE FIELD MECHANICAL & EXHAUST NOISE

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Gen Power With Fan	Percent Load	Engine Power	Overall	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz
ekW	%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
750	1114	100	122.9	107.7	109.4	113.7	110.6	108.2	113.1	111.5	112.0	111.4	109.6
563	853	75	122.3	107.0	108.4	113.9	110.0	108.1	112.9	111.7	111.3	111.1	109.3
375	595	50	121.9	107.0	107.6	113.6	107.8	107.5	113.0	111.7	111.8	110.9	109.1

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Gen Power With Fan	Percent Load	Engine Power	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz
ekW	%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
750	1114	100	109.8	109.0	108.4	106.8	107.5	106.5	105.1	105.8	112.6	103.1	100.6
563	853	75	109.5	108.4	108.0	105.9	106.5	104.9	104.3	108.7	101.6	99.5	98.7
375	595	50	109.2	107.9	107.7	105.7	105.2	105.0	109.0	101.1	99.5	97.3	94.6

EXHAUST: Sound Power (1/3 Octave Frequencies)

Gen Power With Fan	Percent Load	Engine Power	Overall	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz
ekW	%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
750	1114	100	128.5	113.8	121.6	115.1	117.8	120.1	122.0	120.1	113.1	113.7	114.1
563	853	75	127.2	113.5	120.9	114.0	115.4	118.1	120.0	119.2	112.6	112.6	112.5
375	595	50	126.1	112.7	120.5	111.5	113.0	116.1	119.8	118.3	111.7	110.8	110.0

EXHAUST: Sound Power (1/3 Octave Frequencies)

Gen Power With Fan	Percent Load	Engine Power	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz
ekW	%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
750	1114	100	110.5	105.9	104.5	99.9	99.0	99.2	96.2	93.1	96.7	88.3	83.5
563	853	75	109.3	105.1	103.2	97.5	96.7	96.7	94.6	92.6	90.5	85.5	81.3
375	595	50	107.2	103.3	101.2	95.1	94.4	94.7	92.3	91.5	84.7	81.9	77.3

SOUND PARAMETER DEFINITION:

Sound Power Level Data - DM8702-03

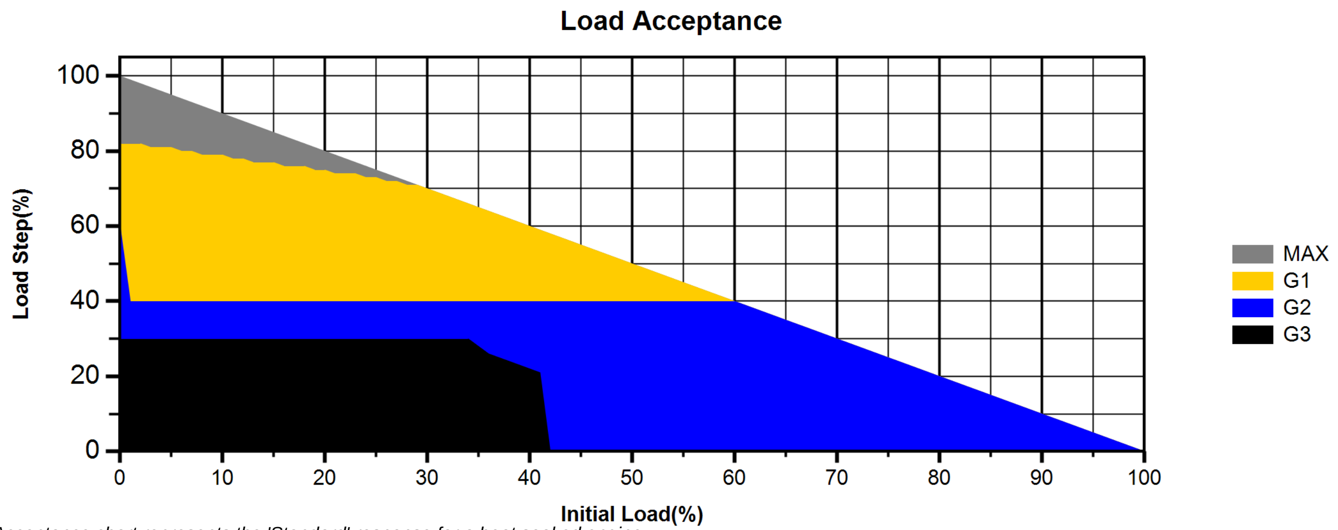
Sound power is defined as the total sound energy emanating from a source irrespective of direction or distance. Sound power level data is presented under two index headings:
Sound power level -- Mechanical
Sound power level -- Exhaust

Mechanical: Sound power level data is calculated in accordance with ISO 3747. The data is recorded with the exhaust sound source isolated.

Exhaust: Sound power level data is calculated in accordance with ISO 6798 Annex A. Exhaust data is post-catalyst on gas engine ratings labeled as "Integrated Catalyst".

Measurements made in accordance with ISO 3747 and ISO 6798 for mechanical and exhaust sound level only. Frequency bands outside the displayed ranges are not measured, due to physical test, and environmental conditions that affect the accuracy of the measurement. No cooling system noise is included unless specifically indicated. Sound level data is indicative of noise levels recorded on one engine sample in a survey grade 3 environment.

How an engine is packaged, installed and the site acoustical environment will affect the site specific sound levels. For site specific sound level guarantees, sound data collection needs to be done on-site or under similar conditions.



Load Acceptance chart represents the 'Standard' response for a heat soaked engine

Transient Load Acceptance

Load Step	Frequency Deviation +/- (%)	Voltage Deviation +/- (%)	Recovery Time (sec)	Classification as Defined by ISO 8528 - 5	Notes
100	+1/-23	+1/-56	6.9/8.4		(5)
75	+1/-15	+2/-35	4.4/6.8	G1	(2)(5)
50	+1/-10	+1/-20	3.4/5.2	G1	(2)(5)
40	+1/-8	+1/-16	3.2/4.3	G2	(3)(5)
30	+1/-5	+1/-9	3/4.2	G2	(3)(5)
25	+1/-4	+1/-8	3.1/3.6	G2	(3)(5)
20	+1/-4	+1/-6	3.3/3	G2	(3)(5)
15	+1/-3	+1/-5	3.3/3	G2	(3)(5)
10	+1/-3	+1/-5	3.3/3	G2	(3)(5)
-20	+2/-1	+1/-1	4.4/4		(5)
-50	+5/-5	+6/-2	3.6		
-75	+6/-4	+10/-5	3.4		
Breaker Open	+8/-1	+12/-1	3.3		(1)
Recovery Specification	+1.75/-1.75	+5/-5			
Steady State Specification	+0.5/-0.5	+0.25/-0.25			(6)

Transient Information

The transient load steps listed above are stated as a percentage of the engine's full rated load as indicated in the appropriate performance technical data sheet. Site ambient conditions, fuel quality, inlet/exhaust restriction and emissions settings will all affect engine response to load change. Engines that are not operating at the standard conditions stated in the Technical data sheet should be set up according to the guidelines included in the technical data; applying timing changes and/or engine derates as needed. Adherence to the engine settings guidelines will allow the engines to retain the transient performance stated in the tables above as a percentage of the site derated power (where appropriate).Fuel supply pressure and stability is critical to transient performance. Proper installation requires that all fuel train components (including filters, shut off valves, and regulators) be sized to ensure adequate fuel be delivered to the engine. The following are fuel pressure requirements to be measured at the engine mounted fuel control valve.

a. Steady State Fuel Pressure Stability +/- .15 psi/sec
b. Transient fuel Pressure Stability +/- .15 psi/sec

Inlet water temperature to the SCAC must be maintained at specified value for all engines. It is important that the external cooling system design is able to maintain the Inlet water temp to the SCAC to within +/- 1 °C during all engine-operating cycles. The SCAC inlet temperature stability criterion is to maintain stable inlet manifold air temperature. The Air Fuel Ratio control system requires up to 180 seconds to converge after a load step has been performed for NOx to return to nominal setting. If the stabilization time is not met between load steps the transient performance listed in the document may not be met. Differences in generator inertia may change the transient response of engine. Engine Governor gains and Voltage regulator settings may need to be tuned for site conditions. Engines must be maintained in accordance to guidelines specified in the Caterpillar Service Manuals applicable to each engine. Wear of components outside of the specified tolerances will affect the transient capability of the engine.

NOTES:

1. For unloading the engine to 0% load from a loaded condition no external input is needed. The engine control algorithm employs a load sensing strategy to determine a load drop. In the event that the local generator breaker opens the strategy provides control to the engine that resets all control inputs to the rated idle condition. This prevents engine over speeding and will allow the engine to remain running unloaded at the rated synchronous speed.
2. The engines specified above have been tested against the voltage deviation, frequency deviation, and recovery time requirements defined in ISO 8528 - 5. At this time the engines stated above will meet class G1 transient performance as defined by ISO 8528 - 5 with exceptions.
3. The engines specified above have been tested against the voltage deviation, frequency deviation, and recovery time requirements defined in ISO 8528 - 5. At this time the engines stated above will meet class G2 transient performance as defined by ISO 8528 - 5 with exceptions.
4. The engines specified above have been tested against the voltage deviation, frequency deviation, and recovery time requirements defined in ISO 8528 - 5. At this time the engines stated above will meet class G3 transient performance as defined by ISO 8528 - 5 with exceptions.
5. Air flow is critical for turbocharged engines during transients. As the exhaust temperature increases, the air flow or turbo response increases to enhance the genset transient response. Therefore, the recovery time for an engine's "First" load step after start up may differ from the "Standard" response for a heat soaked engine. If different, the load step recovery times are illustrated as Standard/First .
6. Steady state voltage and frequency stability specified at +/-2 sigma or better.