



Report No. 20276
December 31, 2008

Torsional Analysis
for
Lei Shing Hong

Reported by:
Deb K Wernsman

A handwritten signature in black ink that reads "Deb K Wernsman".

Vibration Analysis
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Application:	Generator
Engine Model:	3406
S.O. Number:	DLYDW
P.O. Number:	MA29601
Generator Frame:	449

Conclusion

The following analysis indicates this system is free of serious torsional vibration for the normal operating conditions described. Engine front crank amplitudes and crankshaft stresses are acceptable. Stress levels in the generator shaft are within recommended limits.

Caterpillar does not recommend operating any system under engine misfire conditions.

System Data

Engine model 3406 rated at 277 bkW, 1800 rpm operating speed

Engine Damper: Caterpillar Part No. 4P5894

Engine Flywheel: Caterpillar Part No. 7N3060

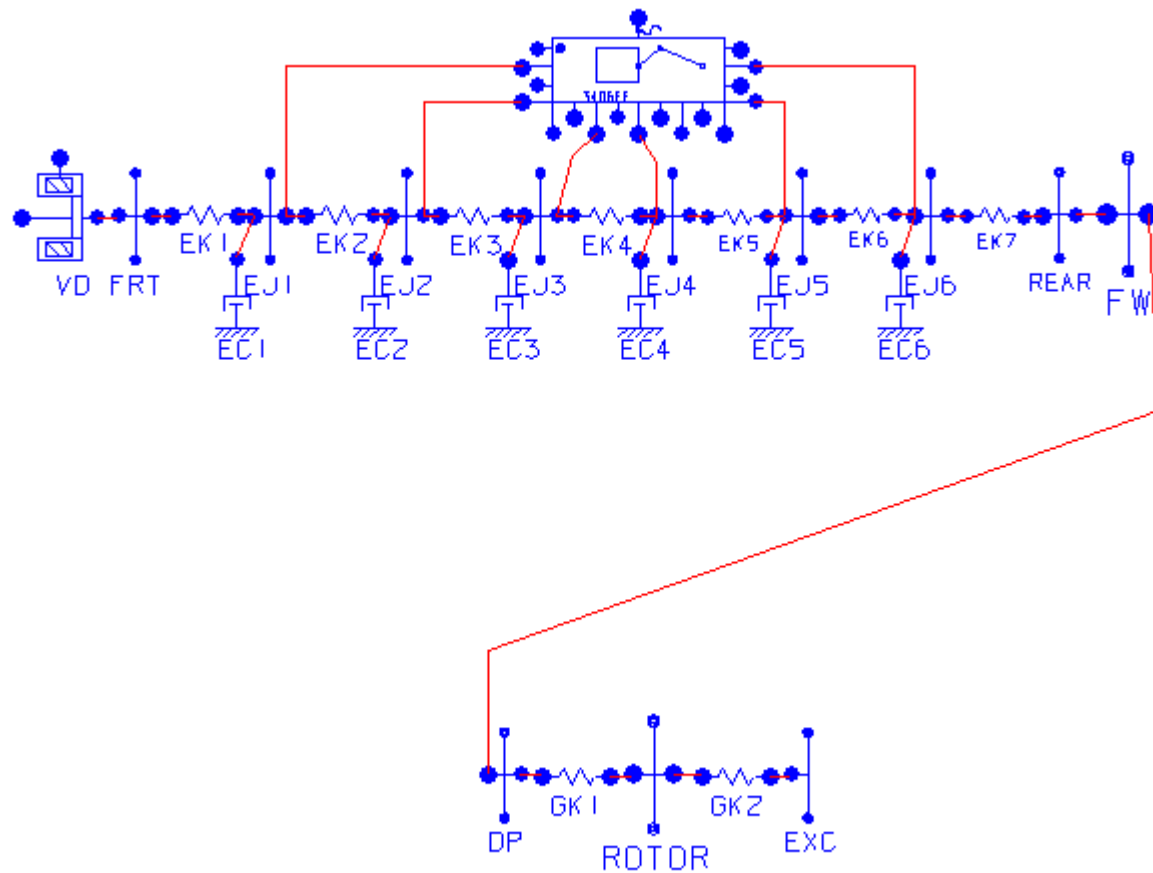
Generator: Caterpillar Part No. 3285996

System Description

The engine is driving a one-bearing generator through flywheel mounted drive plates. The system is designed for constant speed operation at the rated engine speed.

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Damper Parameters

Damper Type	Housing Inertia Nms ²	Ring Inertia Nms ²	Effective Stiffness MNm/rad	Damping Nms/rad
Viscous	0.2635	0.172	0.070	130

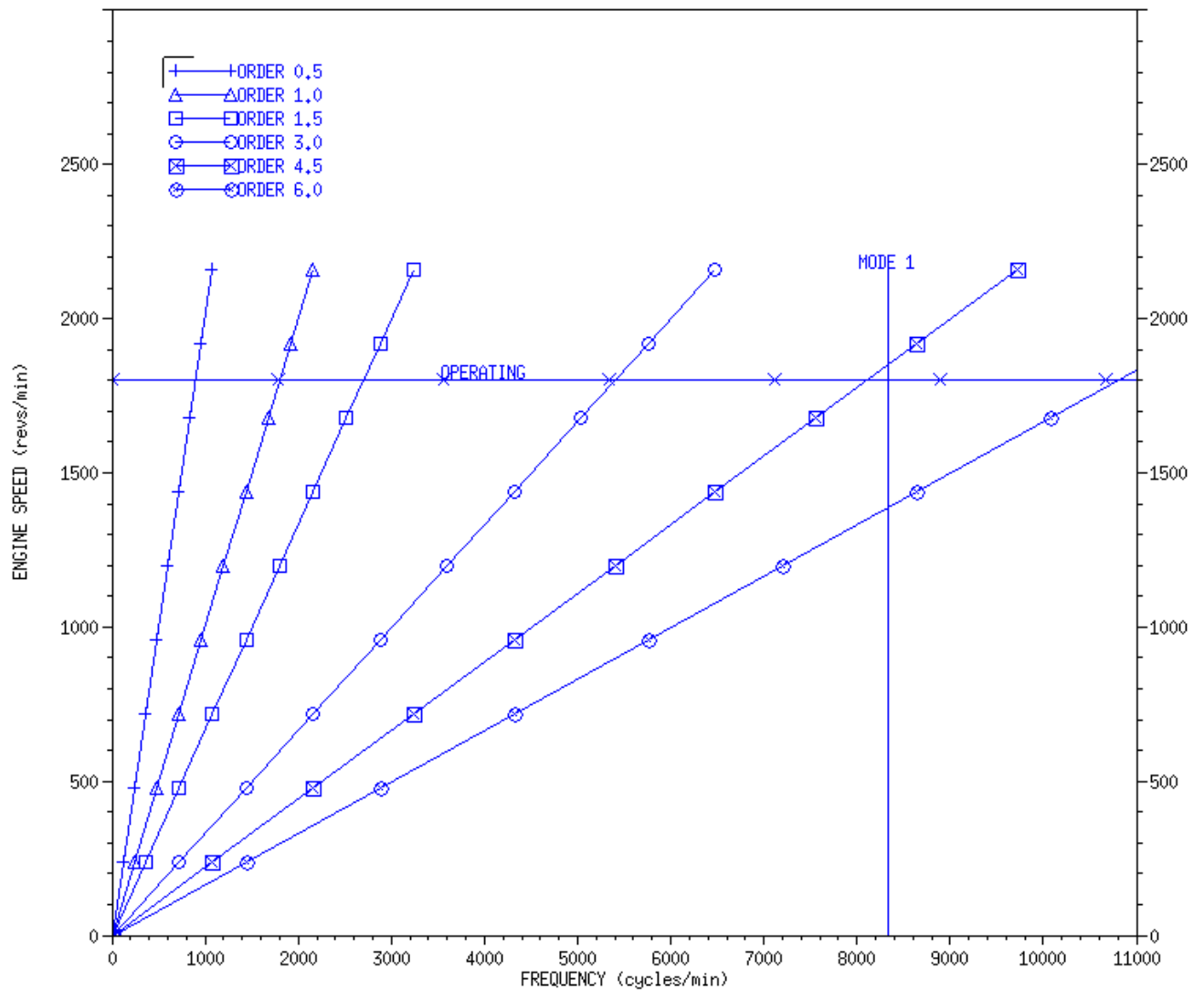
MASS-ELASTIC DATA

MASS ID	MASS NAME	INERTIA (N*m*sec ²)	SPRING ID	STIFFNESS (MN*m/rad)	DIAMETER (mm)
VD		3.495E-01		0.000E+00	0.000E+00
FRT		9.220E-02	EK1	5.540E+00	9.000E+01
EJ1		2.240E-01	EK2	3.680E+00	9.000E+01
EJ2		1.130E-01	EK3	3.680E+00	9.000E+01
EJ3		2.160E-01	EK4	3.600E+00	9.000E+01
EJ4		2.160E-01	EK5	3.680E+00	9.000E+01
EJ5		1.130E-01	EK6	3.680E+00	9.000E+01
EJ6		2.240E-01	EK7	5.750E+00	9.000E+01
REAR		2.410E-02		0.000E+00	0.000E+00
FW		1.964E+00		0.000E+00	0.000E+00
DP		5.050E-01	GK1	4.036E+00	1.016E+02
ROTOR		3.315E+00	GK2	9.400E-01	6.335E+01
EXC		8.100E-02		0.000E+00	0.000E+00

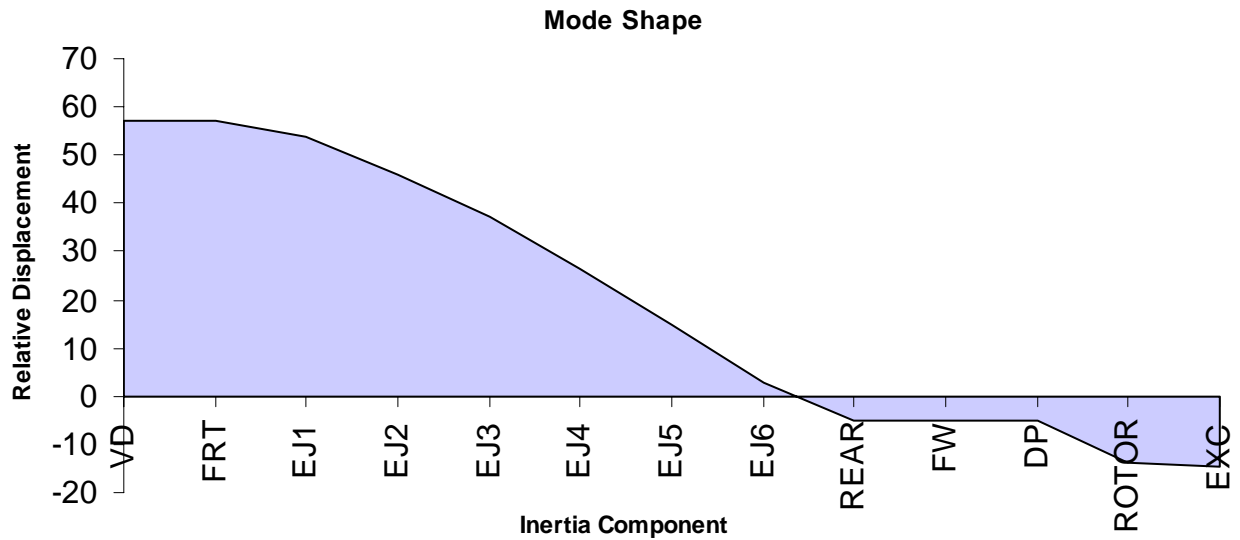
System Damping

Component ID	Damping Nms/rad
EC1 – EC6	36.5 each

Resonant Speed Diagram



First Natural Frequency Occurs at 8334 CPM

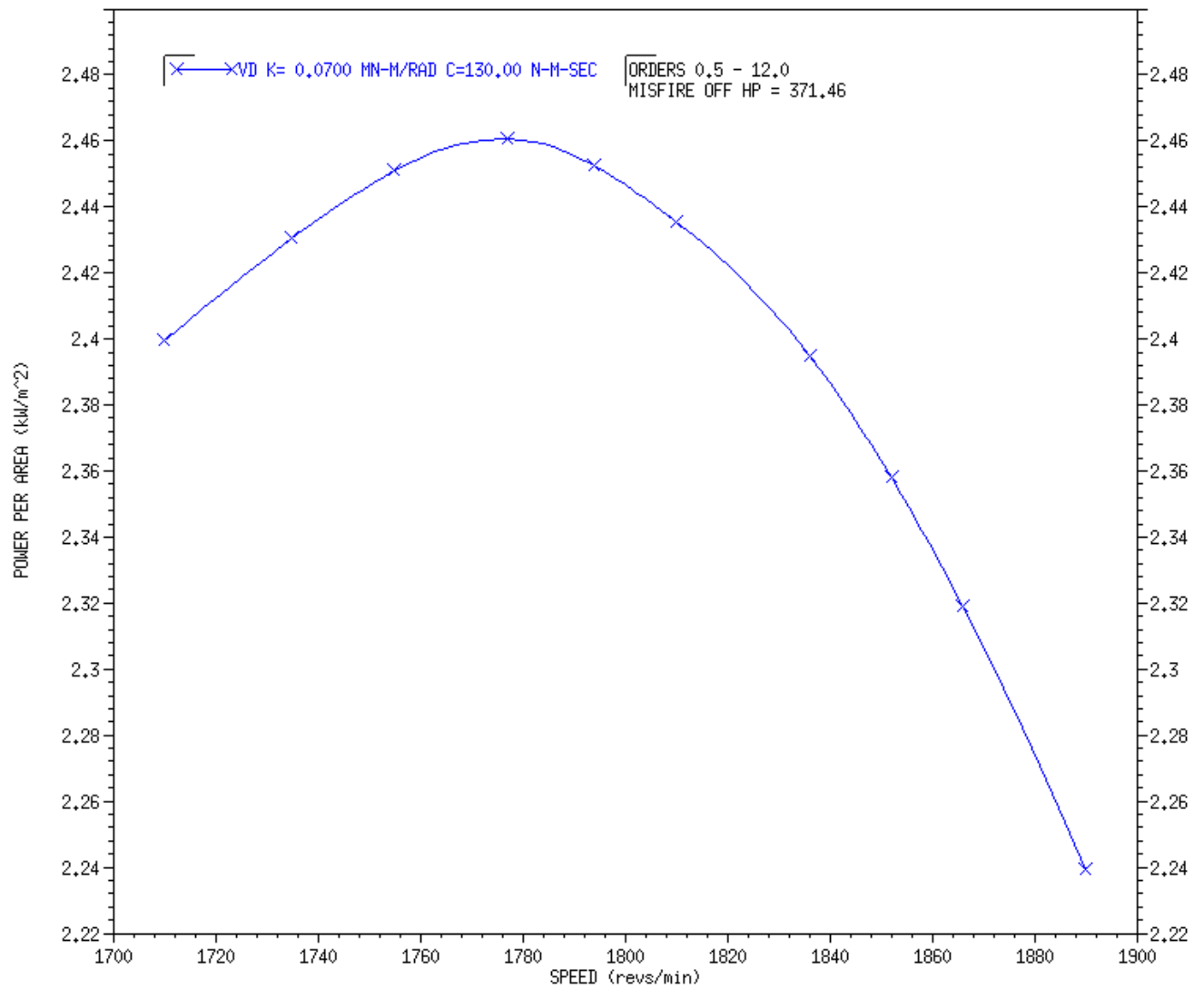


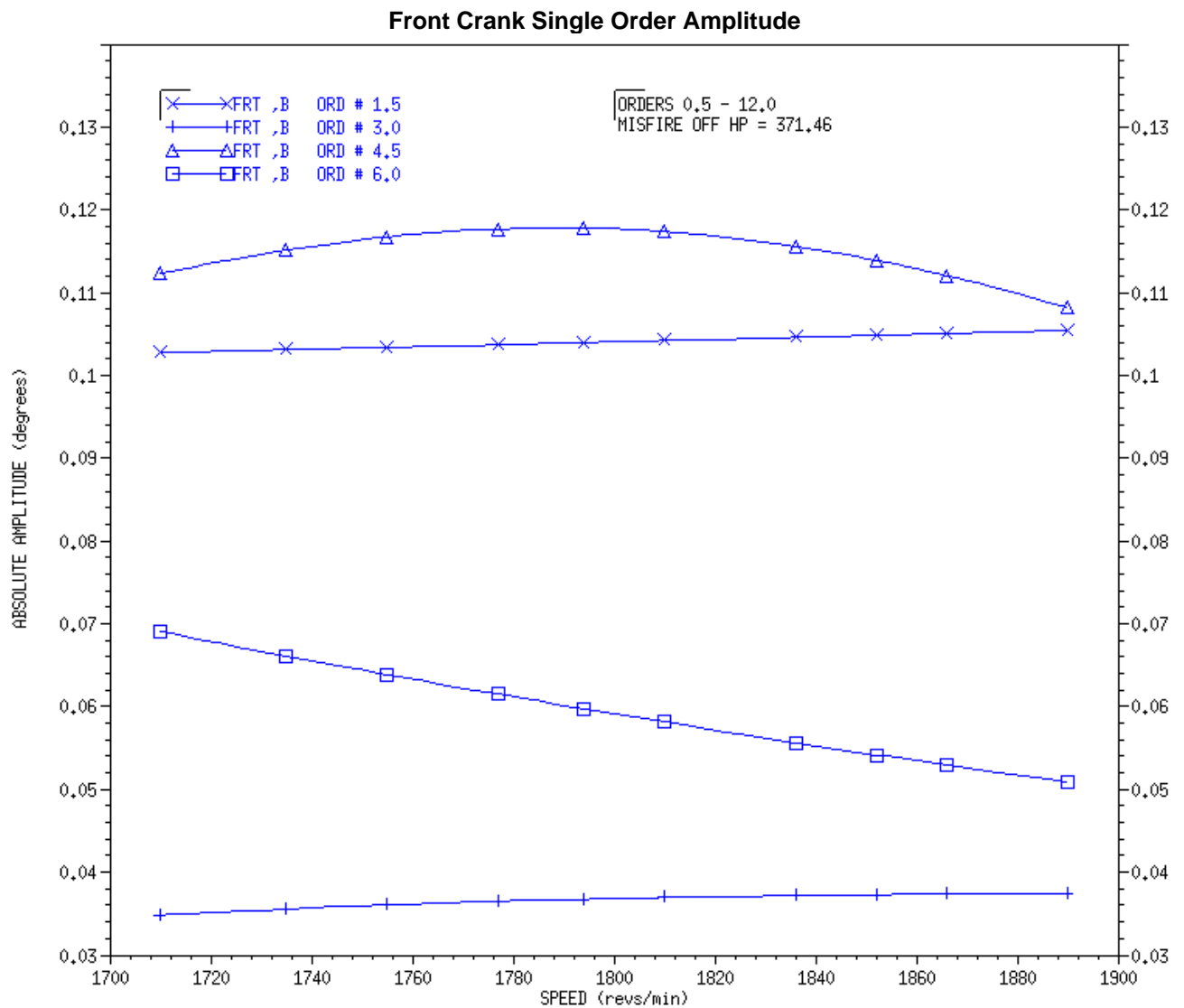
MASS ID	MASS NAME	INERTIA (N*m*sec ²)	DISPLACE (degrees)	SPRING ID	STIFFNESS (MN*m/rad)	CUM TORQUE (N*m)	DIAMETER (mm)	STRESS (MPa)
VD		3.495E-01	5.730E+01		0.000E+00	2.662E+05	0.000E+00	0.000E+00
FRT		9.220E-02	5.730E+01	EK1	5.540E+00	3.364E+05	9.000E+01	4.102E+01
EJ1		2.240E-01	5.382E+01	EK2	3.680E+00	4.967E+05	9.000E+01	6.057E+01
EJ2		1.130E-01	4.608E+01	EK3	3.680E+00	5.659E+05	9.000E+01	6.901E+01
EJ3		2.160E-01	3.727E+01	EK4	3.600E+00	6.730E+05	9.000E+01	8.206E+01
EJ4		2.160E-01	2.656E+01	EK5	3.680E+00	7.492E+05	9.000E+01	9.136E+01
EJ5		1.130E-01	1.490E+01	EK6	3.680E+00	7.716E+05	9.000E+01	9.408E+01
EJ6		2.240E-01	2.882E+00	EK7	5.750E+00	7.802E+05	9.000E+01	9.513E+01
REAR		2.410E-02	-4.893E+00		0.000E+00	7.786E+05	0.000E+00	0.000E+00
FW		1.964E+00	-4.893E+00		0.000E+00	6.509E+05	0.000E+00	0.000E+00
DP		5.050E-01	-4.893E+00	GK1	4.036E+00	6.180E+05	1.016E+02	5.238E+01
ROTOR		3.315E+00	-1.367E+01	GK2	9.400E-01	1.575E+04	6.335E+01	5.507E+00
EXC		8.100E-02	-1.463E+01		0.000E+00	-9.839E-02	0.000E+00	0.000E+00

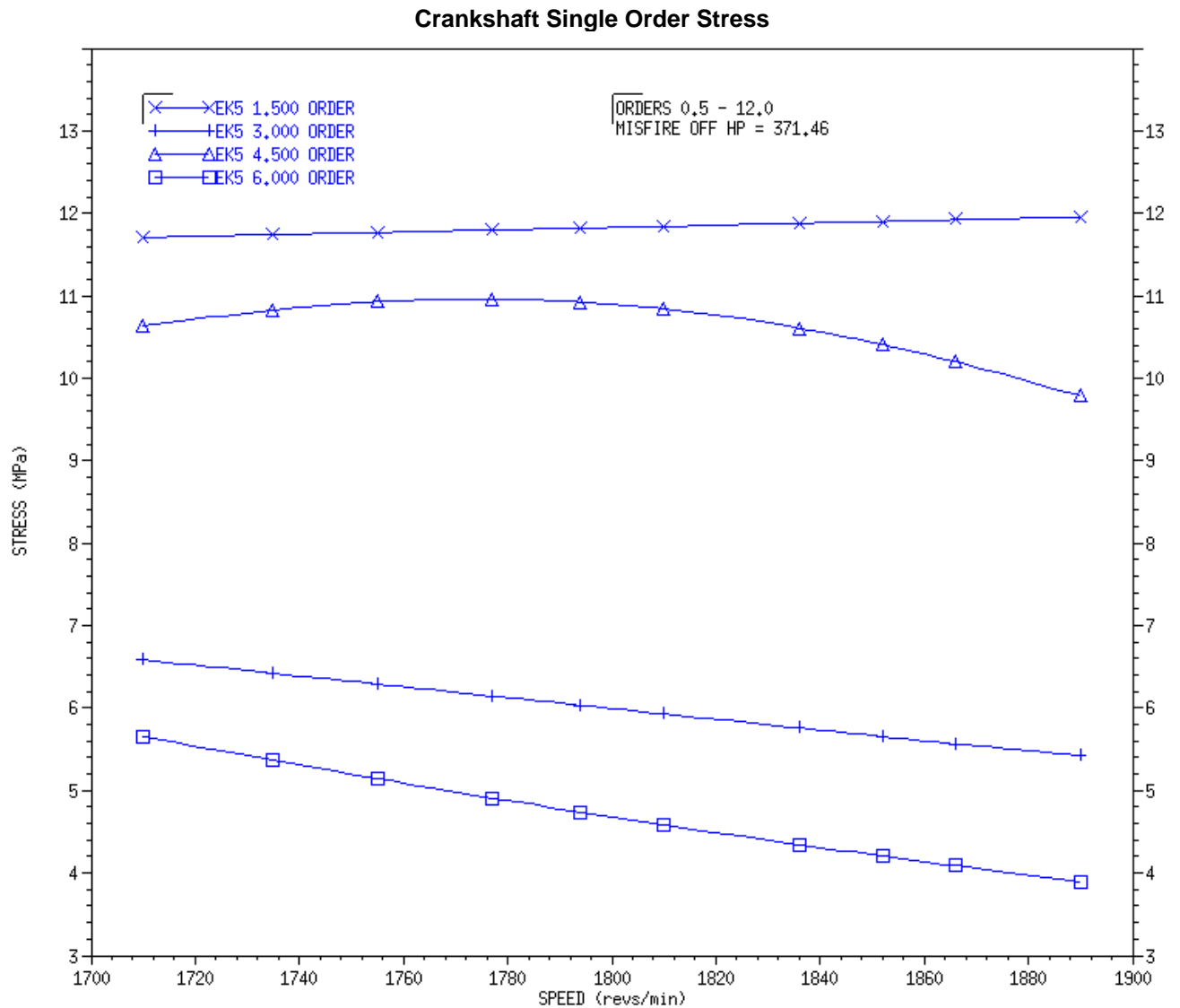
Single Order Results		Order	Predicted	Permissible Limit
FRT	Absolute Amplitude (deg)	1.5	0.105	0.25
	Absolute Amplitude (deg)	3.0	0.037	0.15
	Absolute Amplitude (deg)	4.5	0.118	0.15
	Absolute Amplitude (deg)	6.0	0.069	0.15
EK5	Vibratory Stress (MPa)	1.5	11.96	21.0
	Vibratory Stress (MPa)	3.0	6.58	21.0
	Vibratory Stress (MPa)	4.5	10.96	21.0
	Vibratory Stress (MPa)	6.0	5.65	21.0
GK1	Vibratory Stress (MPa)	1.5	0.51	34.5
	Vibratory Stress (MPa)	3.0	4.02	34.5
	Vibratory Stress (MPa)	4.5	6.25	34.5
	Vibratory Stress (MPa)	6.0	3.46	34.5

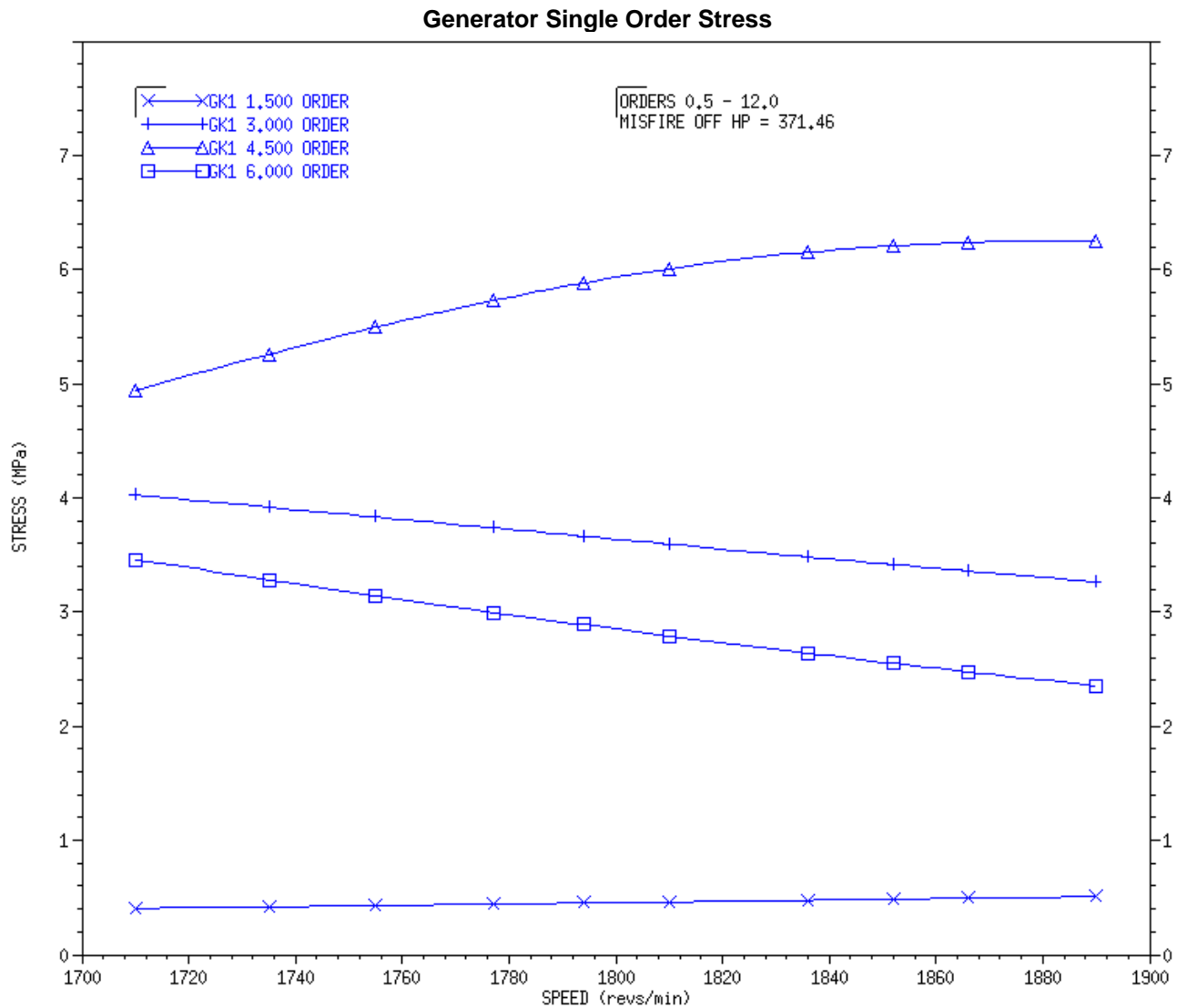
Combined Order Results		Predicted	Permissible Limit
VD	Power Absorbed (kW/m ²)	2.5	4.8

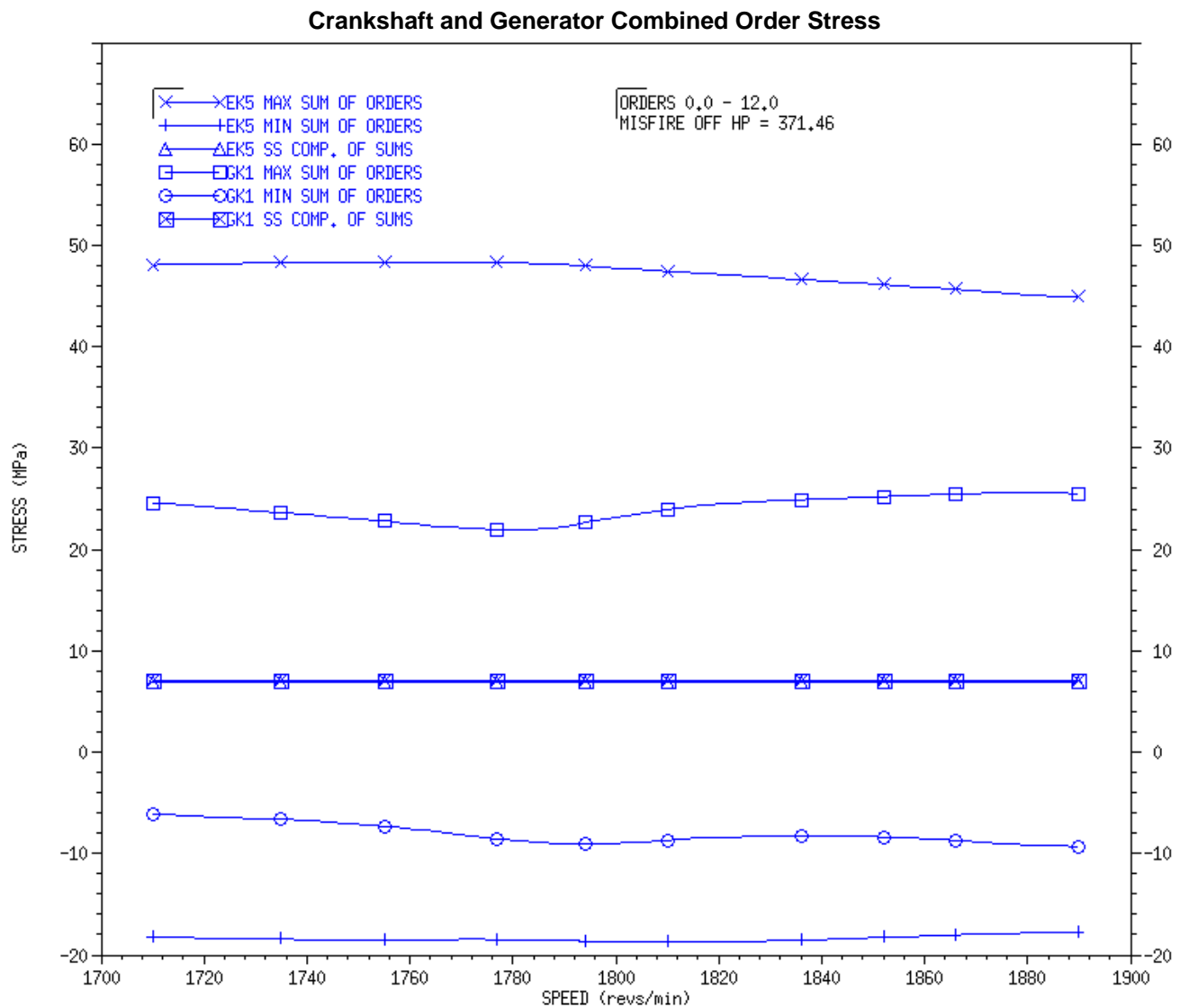
Damper Combined Order Thermal Loading











1. Caterpillar warrants this analysis to be free from errors in calculations. Any damages arising out of an alleged error by Caterpillar in this report shall be limited to a refund of monies paid by the customer to Caterpillar for the report. This warranty is expressly in lieu of any other warranties, expressed or implied, including any warranty of merchantability or fitness for a particular purpose. Remedies under this warranty are limited to a refund as specified above. Caterpillar is not responsible for incidental or consequential damages. Nothing herein is intended to supersede or alter in any manner any of the terms and conditions of, or any rights the purchaser may have under, Caterpillar's standard product warranty.
2. Caterpillar excludes all liability for or arising from any negligence on its part or on the part of any of its employees, agents or representatives in respect of the manufacture or supply of goods or the provision of services relating to the goods.
3. Satisfactory system operation also depends on factors other than torsional vibration. This report should not be used as a guarantee of a successful system installation.
4. This installation has been analyzed under full load from 95% to 105% of the rated speed and under no-load from the low idle speed to 105% of the rated speed.
5. Though all relevant orders of vibration have been analyzed, only significant orders of vibration are included in this report. Combined order results include engine orders 0 through 12. Vibratory amplitudes, stresses and torque's are single amplitude, which means they are +/- from zero.
6. System mass-elastic data values are actual values. Mass-elastic values for components driven through a gearbox are not adjusted to engine speed. The viscous damper inertia is an equivalent inertia equal to the damper housing inertia plus one-half of the damper flywheel inertia.
7. This report contains information from two different analysis methods that produce complementary results. The natural frequency tables and the resonant speed diagram contain no damping or excitation. The forced response results shown in the report include system damping and excitation.