GAS TURBINE VIBRATION LIMITS

TURBO MONITORING

DAMAGE INVESTIGATIONS
VIBRATION ANALYSIS
INSPECTIONS

info@turbomonitoring.com
+31 70 80 80 900

CONTACT US IF YOU REQUIRE ASSISTANCE

	A Newly commissioned machines typically have vibration in this zone	B Acceptable for unrestricted long-term operation	C Unsatisfactory for long-term continuous operation	D Sufficient severity to cause damage to the machine
Small (2) **Gas Turbines** up to 3 MW	3.5 mm/s	7.1 mm/s	11 mm/s	
	$= \frac{4800}{\sqrt{n}}$	$= \frac{9000}{\sqrt{n}}$	$= \frac{13200}{\sqrt{n}}$	
Medium (3) **Gas Turbines** 3 MW to 40 MW	4.5 mm/s	9.3 mm/s	14.7 mm/s	
	$= \frac{4800}{\sqrt{n}}$	$= \frac{9000}{\sqrt{n}}$	$= \frac{13200}{\sqrt{n}}$	
Large (4) **Gas Turbines** 40 MW +	4.5 mm/s	9.3 mm/s	14.7 mm/s	
	90 $\mu m_{p\text{-}p}$	165 $\mu m_{p\text{-}p}$	240 $\mu m_{p\text{-}p}$	

See Comments Overleaf

TURBO MONITORING

DAMAGE INVESTIGATIONS
VIBRATION ANALYSIS
INSPECTIONS

info@turbomonitoring.com
+31 70 80 80 900

CONTACT US IF YOU REQUIRE ASSISTANCE

VIBRATION ANALYSIS

DAMAGE INVESTIGATIONS

INSPECTIONS

Turbo Monitoring is an INDEPENDENT provider of damage investigation services to turbomachinery operators, manufacturers and insurers, helping them clarify the root cause of the damage and providing independent EXPERT ADVICE on the repair

(1) General Notes: -

Bearing vibration is evaluated as r.m.s vibration in mm/s_{rms} only (also known as "overall" or "effective" vibration). The frequency range of measurement is 10 Hz to 1,000 Hz. The direction of measurement is radial, and the location of measurement is on bearing pedestals/housings. The transducers may be placed at any angular location, although usually one sensor each in the vertical and horizontal directions are preferred.

It is not common practice to measure axial vibration on main radial load-carrying bearings during continuous operational monitoring. However, in some cases the limits can be applied to axial vibration when measured on a thrust bearing with axial vibration correlating to the axial pulsations which could cause damage to the axial load-carrying surfaces. Shaft vibration is evaluated as peak-peak vibration in $\mu m_{p\text{-}p}$ only. If peak vibration in μm_{pk} is measured by the operator then the shaft vibration limits displayed here must be divided by 2. The transducers must be located at or close to the bearings. The shaft vibration must be measured relative to the bearing housing. The machine must be operating under steady-state conditions at the rated speed (or within the specified speed range). The limits do not apply when the machine is undergoing a transient condition (i.e. changing speed or load).

(2) Small gas turbines: -

These vibration limits are based on the standards **ISO-10816-3** group 1 flexible foundation and **ISO-7919-3**.

The bearing vibration limits depend on the flexibility of the foundation. The limits shown are for a turbine supported by a foundation with spring supports i.e. "flexible" support. If the turbine is mounted directly to a solid foundation without any spring supports then the "rigid" limits are to be used (Zone A up to 2.3 mm/s, Zone B up to 4.5 mm/s, Zone C up to 7.1 mm/s). (Technically, the decisive factor for the foundation is whether the lowest natural frequency of the combined machine and support system in the direction of measurement is higher than the main excitation frequency (this is in most cases the rotational frequency) by at least 25 %. If this is the case then the support system may be considered rigid in that direction. All other support systems may be considered flexible). The bearing vibration limits are also valid for axial vibration on thrust bearings.

The shaft vibration limits are valid only for turbines with fluid-film bearings (the limits are not valid for rolling-element bearings) and only for turbines with speeds between 1,000 rpm and 30,000 rpm.

(3) Medium gas turbines: -

These vibration limits are based on the standard **ISO-20816-4**. Only applicable to gas turbines with fluid-film bearings, power outputs above 3 MW, and operating speed under load of between 3,000 rpm and 30,000 rpm. Aero-derivative gas turbines are not covered by these limits.

(4) Large gas turbines: -

These vibration limits are based on the standard **ISO-20816-2**. Only applicable to gas turbines with fluid-film bearings, power outputs above 40 MW, and operating speeds of either 1,500 rpm or 3,000 rpm. Turbines with speeds of 1,800 rpm or 3,600 rpm are also covered by this standard but have different vibration limits (not displayed here due to simplicity). Turbines with any other operating speed are covered by ISO-20816-4 (see Medium Gas Turbines limits).

= BEARING VIBRATION mm/s_{rms}

= SHAFT VIBRATION $\mu m_{p\text{-}p}$

n = TURBINE SPEED r.p.m

STEAM TURBINE VIBRATION LIMITS

TURBO MONITORING

DAMAGE INVESTIGATIONS
VIBRATION ANALYSIS
INSPECTIONS

info@turbomonitoring.com
+31 70 80 80 900

CONTACT US IF YOU REQUIRE ASSISTANCE

	A	B	C	D
	Newly commissioned machines typically have vibration in this zone	Acceptable for unrestricted long-term operation	Unsatisfactory for long-term continuous operation	Sufficient severity to cause damage to the machine
Small Turbines (2) up to 40 MW	Rigid → / Flexible → 2.3 / 3.5 mm/s	4.5 / 7.1 mm/s	7.1 / 11 mm/s
	$= \frac{4800}{\sqrt{n}}$	$= \frac{9000}{\sqrt{n}}$	$= \frac{13200}{\sqrt{n}}$
Large 1,500 rpm (3) 40 MW +	2.8 mm/s	5.3 mm/s	8.5 mm/s
	100 $\mu m_{p\text{-}p}$	200 $\mu m_{p\text{-}p}$	320 $\mu m_{p\text{-}p}$
Large 3,000 rpm (4) 40 MW +	3.8 mm/s	7.5 mm/s	11.8 mm/s
	90 $\mu m_{p\text{-}p}$	165 $\mu m_{p\text{-}p}$	240 $\mu m_{p\text{-}p}$

See Comments Overleaf

TURBO MONITORING

DAMAGE INVESTIGATIONS
VIBRATION ANALYSIS
INSPECTIONS

info@turbomonitoring.com
+31 70 80 80 900

CONTACT US IF YOU REQUIRE ASSISTANCE

VIBRATION ANALYSIS
DAMAGE INVESTIGATIONS
INSPECTIONS

Turbo Monitoring is an INDEPENDENT provider of damage investigation services to turbomachinery operators, manufacturers and insurers, helping them clarify the root cause of the damage and providing independent EXPERT ADVICE on the repair

(1) General Notes: -

Bearing vibration is evaluated as r.m.s vibration in mm/s_{rms} only (also known as "overall" or "effective" vibration). The frequency range of measurement is 10 Hz to 1,000 Hz. The direction of measurement is radial, and the location of measurement is on bearing pedestals/housings. The transducers may be placed at any angular location, although usually one sensor each in the vertical and horizontal directions are preferred.

It is not common practice to measure axial vibration on main radial load-carrying bearings during continuous operational monitoring. However, in some cases the limits can be applied to axial vibration when measured on a thrust bearing with axial vibration correlating to the axial pulsations which could cause damage to the axial load-carrying surfaces. Shaft vibration is evaluated as peak-to-peak vibration in $\mu m_{p\text{-}p}$ only. If peak vibration in μm_{pk} is measured by the operator then the shaft vibration limits displayed here must be divided by 2. The transducers must be located at or close to the bearings. The shaft vibration must be measured relative to the bearing housing. The machine must be operating under steady-state conditions at the rated speed (or within the specified speed range). The limits do not apply when the machine is undergoing a transient condition (i.e. changing speed or load). The limits shown are for small steam turbines of any speed, and large turbines with speeds 1,500 rpm or 3,000 rpm. Turbines with speeds of 1,800 rpm or 3,600 rpm are also covered by the relevant standards but have different vibration limits and are not displayed here due to simplicity.

(2) Small steam turbines: -

These vibration limits are based on the standards **ISO-10816-3** group 1 and **ISO-7919-3**.

The bearing vibration limits depend on the flexibility of the foundation, whereby either a "flexible" or a "rigid" support for the foundation is present. If the turbine is mounted directly to a solid foundation without any spring supports then the "rigid" limits are to be used. If spring supports are used then the "flexible" limits are typically used. Technically, the decisive factor for the foundation type is whether the lowest natural frequency of the combined machine and support system in the direction of measurement is higher than the main excitation frequency (this is in most cases the rotational frequency) by at least 25 %. If this is the case then the support system may be considered rigid in that direction. All other support systems may be considered flexible. The bearing vibration limits are also valid for axial vibration on thrust bearings.

The shaft vibration limits are valid only for turbines with fluid-film bearings (the limits are not valid for rolling-element bearings) and only for turbines with speeds between 1,000 rpm and 30,000 rpm.

(3) Large 1,500 rpm steam turbines: -

These vibration limits are based on the standard **ISO-20816-2**. Only applicable to steam turbines with fluid-film bearings, power outputs above 40 MW, and operating speed under load of 1,500 rpm.

(4) Large 3,000 rpm steam turbines: -

These vibration limits are based on the standard **ISO-20816-2**. Only applicable to steam turbines with fluid-film bearings, power outputs above 40 MW, and operating speed under load of 3,000 rpm.

= BEARING VIBRATION mm/s_{rms}

= SHAFT VIBRATION $\mu m_{p\text{-}p}$

n = TURBINE SPEED r.p.m