Vibration Isolation: Transmissibility and Isolator Deflection

Force transmissibility and isolation efficiency of a mounted machine from running speed, mount natural frequency and damping, and deflection needed.

Method: Rao; Mechanical Vibrations; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Disturbing (running) frequency	1,480.0	rpm
Mounted natural frequency	5.0000	Hz
Damping ratio	5.0000	%
Target isolation efficiency	90.000	%

Calculated results

Parameter	Value	Unit
Frequency ratio f/f_n	4.9333	
Transmissibility	0.047769	
Isolation efficiency	95.223	%
Natural frequency for the target (undamped)	7.4373	Hz
Static deflection for the target	4.4909	mm

Formula and method

$$TR = \sqrt{\frac{1 + (2\zeta r)^2}{(1 - r^2)^2 + (2\zeta r)^2}}, \quad r = \frac{f}{f_n}, \quad \delta_{req} = \frac{g}{(2\pi f_{n,req})^2}$$

Variables

N	Disturbing (running) frequency	1/s
f_n	Mounted natural frequency	1/s
ζ	Damping ratio	-
η_t	Target isolation efficiency	-
r	Frequency ratio f/f_n	-
TR	Transmissibility	-
η	Isolation efficiency	-
$f_{n,req}$	Natural frequency for the target (undamped)	1/s
δ_{req}	Static deflection for the target	m

Method and standards

Single-degree-of-freedom base isolation.

Assumptions and limits

- The required natural frequency and static deflection are for an undamped, linear mount: δ = g/(2πf_n)² holds only for mounts whose deflection is proportional to load (steel springs, not rubber in its stiffening range). Damping raises the transmissibility above √2, so allow some margin.
- At exact resonance with zero damping the transmissibility is unbounded and not shown.
- Single degree of freedom; vertical mode.

References

- Rao

- Mechanical Vibrations
- 6th ed. (Pearson, 2017)
- ch. 3 (force transmissibility)

Report details

Report reference	FCC-D88W-RY74 (the same inputs always give the same reference)
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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/statics-dynamics/vibration-isolation-transmissibility

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.