# Machine Fault Frequencies: Gear Mesh, Belt and Blade Pass

Gear mesh frequency and its sidebands, belt pass frequency and vane or blade pass frequency from speeds, tooth and blade counts and belt dimensions.

**Method:** Machinery vibration kinematics (gear mesh z f, belt π D f / L, blade pass n f)

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Driving shaft speed | 1,480.0 | rpm |
| Teeth on the driving gear | 23.000 | |
| Teeth on the driven gear | 71.000 | |
| Driving pulley pitch diameter | 200.00 | mm |
| Belt length | 2.0000 | m |
| Vanes or blades on the impeller | 6.0000 | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Gear mesh frequency $z_1$ $f_1$ | 567.33 | Hz |
| Driven shaft speed | 479.44 | rpm |
| Hunting tooth frequency | 0.34742 | Hz |
| Belt pass frequency | 7.7493 | Hz |
| Vane or blade pass frequency (on the driving shaft) | 148.00 | Hz |

**Notes for this case**

- Sidebands around the gear mesh frequency at $f_1$ and $f_2$ point to the gear with the fault.

## Formula and method

$$GMF = z_1 f_1, \quad f_2 = f_1 \frac{z_1}{z_2}, \quad f_{ht} = \frac{GMF \, \gcd(z_1, z_2)}{z_1 z_2}, \quad f_b = \frac{\pi D_p f_1}{L_b}, \quad f_v = n_b f_1$$

### Variables

| | | |
|---|---|---|
| $f_1$ | Driving shaft speed | 1/s |
| $z_1$ | Teeth on the driving gear | - |
| $z_2$ | Teeth on the driven gear | - |
| $D_p$ | Driving pulley pitch diameter | m |
| $L_b$ | Belt length | m |
| $n_b$ | Vanes or blades on the impeller | - |
| $GMF$ | Gear mesh frequency $z_1$ $f_1$ | 1/s |
| $f_2$ | Driven shaft speed | 1/s |
| $f_{ht}$ | Hunting tooth frequency | 1/s |
| $f_b$ | Belt pass frequency | 1/s |
| $f_v$ | Vane or blade pass frequency (on the driving shaft) | 1/s |

### Method and standards

Kinematics of gears, belts and impellers.

### Assumptions and limits

- No slip. Tooth and blade counts must be whole numbers.

- The blade-pass and belt frequencies use the driving shaft speed $f_1$: if the impeller is on the driven shaft (after the gear or belt), enter that shaft's speed; the belt pass assumes the pitch diameter is on the driving pulley.

### References

- Machinery vibration kinematics (gear mesh z f, belt π D f / L, blade pass n f)

## Report details

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|---|---|
| Report reference | FCC-YWTA-8CEZ (the same inputs always give the same reference) |
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| Release checks | 3 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/instrumentation/vibration-noise/machine-fault-frequencies

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.