Intrinsic Safety: Maximum Cable Length by Entity Parameters

Maximum cable length of an intrinsically safe loop from the barrier's allowed capacitance and inductance, the device's internal values and the cable's.

Method: Entity concept for intrinsically safe loops; Intrinsic safety entity concept: cable parameters against source Co and Lo

Input parameters

Unit system: SI

Parameter	Value	Unit
Barrier maximum external capacitance	0.083000	µF
Barrier maximum external inductance	3.0000	mH
Device internal capacitance	0.005000	µF
Device internal inductance	0.010000	mH
Cable capacitance per km	100.00	nF/km
Cable inductance per km	0.70000	mH/km

Calculated results

Parameter	Value	Unit
Length limit by capacitance	0.78000	km
Length limit by inductance	4.2714	km
Maximum cable length	0.78000	km

Notes for this case

• Entity check: C_i + C_cℓ ≤ C_o and L_i + L_cℓ ≤ L_o, so ℓ = min[(C_o − C_i)/C_c, (L_o − L_i)/L_c]. Where both C_i and L_i exceed 1 % of the allowed values, stricter combined rules apply; the cable's L/R ratio may be used instead of its inductance if the barrier states an L/R limit. Voltage, current and power must also match (U_i ≥ U_o, etc.).

Formula and method

$$\ell_{max} = \min\left(\frac{C_o - C_i}{C_c}, \frac{L_o - L_i}{L_c}\right)$$

Variables

C_o	Barrier maximum external capacitance	F
L_o	Barrier maximum external inductance	H
C_i	Device internal capacitance	F
L_i	Device internal inductance	H
C_c	Cable capacitance per km	F/m
L_c	Cable inductance per km	H/m
ℓ_C	Length limit by capacitance	m
ℓ_L	Length limit by inductance	m
ℓ_{max}	Maximum cable length	m

Method and standards

IS cable length.

Assumptions and limits

- Simple entity check; one barrier and one device.

References

Entity concept for intrinsically safe loops, Intrinsic safety entity concept: cable parameters against source Co and Lo

Report details

Report reference	FCC-5TJ8-CWB3 (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/signals-calibration/intrinsic-safety-cable-length

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.