

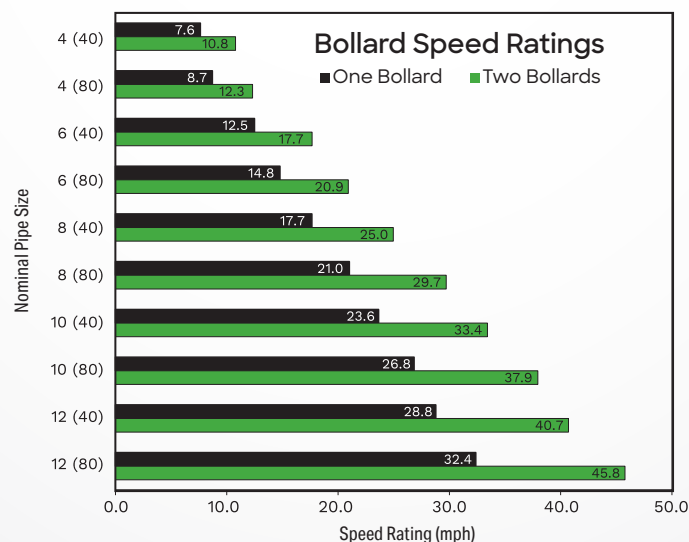
# PEDESTRIAN SAFETY CALCULATOR

## Bollard Strength Table

ASTM Steel Type A53-A  
 Yield Strength 30000 psi  
 Ultimate Strength 48000 psi  
 Allowable Bollard Deflection Distance 2 ft  
 Vehicle Weight 5000 lb  
 Contact Height 14 in

Nominal Pipe Size (in) (sch)		I.D. (in)	O.D. (in)	Wall Thickness (in)	Yield Speed <sup>1</sup> (mph)	Speed Rating <sup>2</sup> (mph)	Yield Speed <sup>1</sup> (mph)	Speed Rating <sup>2</sup> (mph)
4	40	4.026	4.500	0.237	9.3	7.6	13.2	10.8
4	80	3.826	4.500	0.337	10.7	8.7	15.1	12.3
6	40	6.065	6.625	0.280	15.3	12.5	21.6	17.7
6	80	5.761	6.625	0.432	18.1	14.8	25.6	20.9
8	40	7.981	8.625	0.322	21.6	17.7	30.6	25.0
8	80	7.625	8.625	0.500	25.7	21.0	36.4	29.7
10	40	10.020	10.750	0.365	28.9	23.6	40.9	33.4
10	80	9.750	10.750	0.500	32.9	26.8	46.5	37.9
12	40	12.000	12.750	0.375	35.3	28.8	49.9	40.7
12	80	11.750	12.750	0.500	39.6	32.4	56.1	45.8

1,2 Refer to next page for additional considerations.



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<sup>1</sup> The Yield Speed is based upon an energy analysis that assumes that the ability of a bollard to resist the movement of an impacting vehicle is limited by the yield strength of the material from which it is constructed. This assumption provides a conservative analysis, since a bollard's ability to resist an impact is actually limited by its ultimate strength. The Yield Speed has been estimated from an energy analysis that includes considerations for the material properties of various grades of steel pipe under static loads, but does not take into account the impulse force of an actual vehicle collision. The Yield Speed should not be interpreted the true limit of a bollard's performance, or an indication of the speed at which a vehicle could impact a bollard and be stopped.

<sup>2</sup> The Speed Rating is based upon the same analysis as is the Yield Speed, with the additional assumption that the steel will only provide 66% of its specified yield strength under an impact condition. This assumption provides a safety factor to account for the differences between static loads and vehicle impacts, and to ensure that the actual performance of the bollard material will always exceed the Speed Rating.

This worksheet is intended to illustrate the relative material strength of various sizes of pipe bollards for planning purposes only. It is not intended to be a design tool, or provide engineered solutions to your storefront protection requirements. Bollard systems for any specific site must be part of a complete design that takes into consideration the site's land use, geotechnical data, hydrologic data, traffic patterns, existing and proposed utilities, elevation differentials (e.g. curbs), and other important features that might not be apparent.

All of the calculations in this worksheet assume that the bollard(s) are embedded in a foundation that can withstand the internal pressure induced by the applied loads, and is adequate to counter the applied force and over-turning moment generated by this force without excessive movement. If you intend to install a bollard system as a protective device for your storefront or other location, it is critical that the foundation(s) for each bollard system be designed in accordance with the expected loads, local building codes, and site-specific data. Bollard foundations must be specifically engineered as a part of the overall design or retrofit of a facility. Expert Engineering Sciences can provide civil engineering services for the installation of bollards at storefronts, building sites, and for other permanent and temporary projects

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