Tech Note - 09

Surveillance Systems that Work!™

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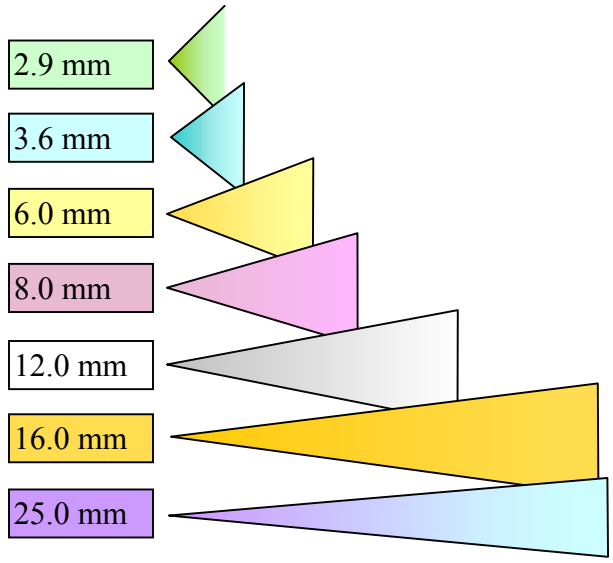
Fixed Lens Focal Length – License Plates

While there is application for adjustable focal length (VariFocal) lenses – when the desired picture is between fixed lens options or when a customer is not sure what picture they want – these solutions are generally more expensive (initial installation) and require periodic maintenance. The purpose of this tech note is to provide the reader with a "feeling" for the kind of image one can expect from various focal length lenses and hopefully, minimize the "guesswork" of lens selection. We've chosen, for purposes of this discussion, to use a vehicle license plate as the focal point of reference.

Field of View – The Graphic Perspective



The simple graphic to the left details the horizontal field of view (plan view) that various fixed focal length lenses provide.

The rule of thumb is: A longer focal length lens will make objects appear closer but the field of view will be narrower.

Field of View – The Tabular Perspective

Lens Focal Len. (mm)	FoV Deg.	Feet From Lens										
		5	6	7	10	12	15	20	25	30	40	50
		Horizontal Field of View (FoV)										
2.9	90	10.0	12.0	14.0	20.0	24.0	30.0	40.0	50.0	60.0	80.0	100.0
3.6	74	7.5	9.0	10.5	15.0	18.0	22.5	30.0	37.5	45.0	60.0	75.0
6	42	3.8	4.6	5.3	7.6	9.1	11.4	15.2	19.0	22.8	30.4	38.0
8	32	2.9	3.5	4.1	5.8	7.0	8.7	11.6	14.5	17.4	23.2	29.0
12	22	1.9	2.3	2.7	3.8	4.6	5.7	7.6	9.5	11.4	15.2	19.0
16	15	1.3	1.6	1.8	2.6	3.1	3.9	5.2	6.5	7.8	10.4	13.0

The above table details the HORIZONTAL field of view provided by various fixed focal length lenses while the table on the top of the next page shows VERTICAL fields of view for the same lenses.

Lens Focal Len. (mm)	FoV Deg.	Feet From Lens										
		5	6	7	10	12	15	20	25	30	40	50
		Vertical Field of View (FoV)										
2.9	67	6.6	7.9	9.2	13.2	15.8	19.8	26.4	33.0	39.6	52.8	66.0
3.6	55	5.2	6.2	7.3	10.4	12.5	15.6	20.8	26.0	31.2	41.6	52.0
6	32	2.9	3.5	4.1	5.8	7.0	8.7	11.6	14.5	17.4	23.2	29.0
8	24	2.1	2.5	2.9	4.2	5.0	6.3	8.4	10.5	12.6	16.8	21.0
12	17	1.5	1.8	2.1	3.0	3.6	4.5	6.0	7.5	9.0	12.0	15.0
16	11	1.0	1.2	1.4	2.0	2.4	3.0	4.0	5.0	6.0	8.0	10.0

The graphic perspective is nice to use when putting together a system-wide camera layout. Graphic layouts tend to be very easy to understand.

Alternatively, if you're camera will be located 50 feet from a 30 foot wide driveway entrance and your desired field of view is about 5 feet on either side of the entrance, it's a simple process to go to the HORIZONTAL FoV table and quickly conclude a 6.0mm lens will provide a 38 foot wide field of view. Likewise, if a camera were to be positioned – say 15 feet away from an entrance doorway (to get a nearly flat horizontal perspective, one could quickly review the VERTICAL FoV table to conclude a 12mm lens would only provide 4.5 feet of vertical video (too small) and thus it would be necessary to move to an 8mm lens (that provides an 8.4 foot vertical FoV).

For purposes of "providing color" to the above technically oriented information let's also consider a real world video review.

Evaluation Setup

Q: A customer has two cameras mounted on opposing vertical poles that support their gas station – convenience store gas island canopy. The vertical support poles are 20 feet apart from each other. What focal length lens do they need?

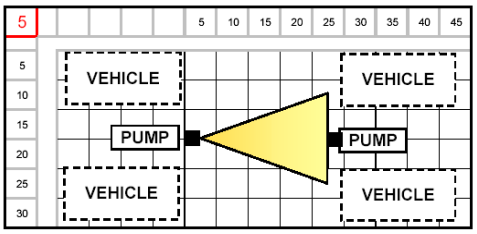
A: We don't have enough information.

- If each camera is to survey the vehicles on either side of the opposing poles pump then (leaving ~8 feet for the pump and air distance to a vehicle on either side and adding an additional 6-7 feet per vehicle) we can estimate the HfoV required is about 20 feet. From the HFoV table (previous page) we'd conclude the customer needs a lens with a focal length somewhere between a 3.6mm and a 6mm.

- Presuming the customer is looking to obtain license plate identification of the vehicles fueling at his/her pumps, then the HFoV requirements change. Looking at our chart, it may be possible for one camera, equipped with a 6mm lens to capture

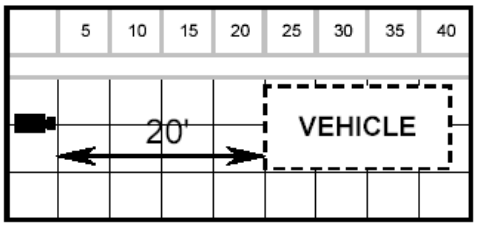
two license plates – one from each vehicle on either side of the pump, however, given that we're now trying to identify a 1' wide tag across a 15.2' HFoV, it's likely that we're not going to be able to differentiate the letters and numbers. Perhaps two cameras on each canopy support pole – each surveying only one side of the fuel pump would be a better approach?

This precise question was posed to ***GuardDog Surveillance*** and as such, we took the time to conduct and actual camera evaluation. Below is a simple graphic detailing the question.



Using this one camera, 6mm lens graphic it's now easy to question whether or not we're going to even see license tags on two vehicles not to mention if either will be readable.

Since the graphic did not provide any conclusive answers we elected to conduct an actual camera test. Below is our test setup.



CD-05 Camera (480L), 8mm Lens

CD-05 Camera (480L), 12mm Lens

CONCLUSIONS

1. If we cannot read the plate with an 8mm lens, we'll never be able to with a 6mm lens.

2. Since accurate ID of the plate was not possible with an 8mm lens we had to move to a 12mm. From the picture (as well as our HFoV chart) we can tell we're not going to be

able to capture two vehicles with one camera. Thus, we need two cameras – each focused on only one fuel lane – on each canopy support pole.

Additional Trial

Since we had the camera evaluation setup, we decided (just for this Tech Note) to increase the distance to 30 feet and capture images from a host of various focal length lenses.

Summary

While one does not need to be a NASA PHD to understand camera lens focal lengths and their effects on the images they create, with a couple of tools (graphic layouts and FoV tables) and a little “hands on experience” it’s not too difficult to make some rather accurate lens sizing predictions.

Getting a handle on this subject will help make proposals more accurate, less expensive and in the long run, ***GuardDog’s*** Tech Support will keep us on the cutting edge of all video surveillance system technology.

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