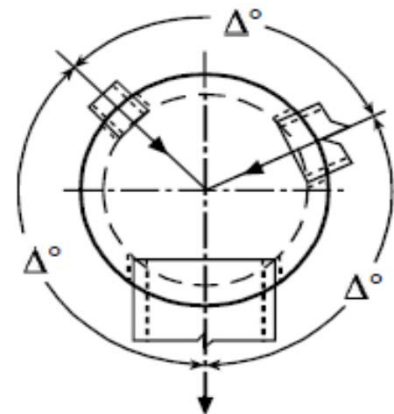


Allowable Angles in Round Manholes for Concrete Pipe using Grouted Connections

MH Dia	Allowable Angle							
	Pipe ID	(inches)	12	15	18	21	24	27
		Opening	21	24	27	30	34	36
48	12	21	67					
	15	24	71	75				
	18	27	75	79	83			
	21	30	79	84	88	92		
	24	34	86	90	94	99	105	
	27	36	89	93	98	102	109	112

MH Dia	Allowable Angle										
	Pipe ID	(inches)	12	15	18	21	24	27	30	36	42
		Opening	21	24	27	30	34	36	42	50	57
60	12	21	53								
	15	24	56	59							
	18	27	59	62	65						
	21	30	62	66	69	72					
	24	34	67	70	73	76	81				
	27	36	69	72	76	79	83	86			
	30	42	77	80	83	86	91	93	101		
	36	50	89	92	95	98	103	105	113	125	
	42	57	104	107	111	114	118	121	128	140	156



Equations:

$$A_o = \text{asin} (O_{po} / ID_m)$$

$$A_i = \text{asin} (O_{pi} / ID_m)$$

$$A_c = \text{Clear Cir} / ID_m / \pi \times 360$$

$$\text{MinAng} = A_o + A_i + A_c$$

Notes:

Allowable angles shown based upon Concrete Pipe to be grouted straight into openings in field with 6" clear for 48" - 72" manholes and 8" clear for 84" - 126" manholes with matching centerlines. Vertical separation may allow smaller angles. Local jurisdictions may require larger angles between pipe openings or larger manholes than shown.

Allowable Angles in Round Manholes for Concrete Pipe using Grouted Connections

MH Dia	Allowable Angle											
	Pipe ID	(inches)	12	15	18	21	24	27	30	36	42	48
		Opening	21	24	27	30	34	36	42	50	57	64
72	12	21	44									
	15	24	46	49								
	18	27	49	52	54							
	21	30	52	54	57	59						
	24	34	55	58	60	63	66					
	27	36	57	60	62	65	68	70				
	30	42	63	65	68	70	74	76	81			
	36	50	71	74	76	79	82	84	90	98		
	42	57	79	82	84	87	91	92	98	106	115	
	48	64	90	92	95	97	101	103	108	117	125	136

MH Dia	Allowable Angle													
	Pipe ID	(inches)	12	15	18	21	24	27	30	36	42	48	54	60
		Opening	21	24	27	30	34	36	42	50	57	64	72	78
84	12	21	40											
	15	24	42	45										
	18	27	45	47	49									
	21	30	47	49	51	53								
	24	34	50	52	54	56	59							
	27	36	51	53	56	58	61	62						
	30	42	56	58	60	62	65	67	71					
	36	50	62	65	67	69	72	73	78	84				
	42	57	69	71	73	75	78	80	84	91	97			
	48	64	76	78	80	82	85	86	91	98	104	111		
	54	72	85	87	89	91	94	96	100	107	113	120	129	
	60	78	94	96	98	101	104	105	110	116	122	129	139	148

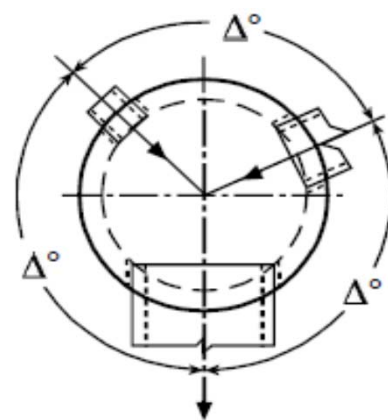
Equations:

$$A_o = \text{asin} (O_{po} / ID_m)$$

$$A_i = \text{asin} (O_{pi} / ID_m)$$

$$A_c = \text{Clear Cir} / ID_m / \pi \times 360$$

$$\text{MinAng} = A_o + A_i + A_c$$



Notes:

Allowable angles shown based upon Concrete Pipe to be grouted straight into openings in field with 6" clear for 48" - 72" manholes and 8" clear for 84" - 126" manholes with matching centerlines. Vertical separation may allow smaller angles. Local jurisdictions may require larger angles between pipe openings or larger manholes than shown.

Allowable Angles in Round Manholes for Concrete Pipe using Grouted Connections

MH Dia	Allowable Angle													
	Pipe ID	(inches)	12	15	18	21	24	30	36	42	48	54	60	66
	Opening		21	24	27	30	34	42	50	57	64	72	78	86
96	12	21	35											
	15	24	37	39										
	18	27	39	41	43									
	21	30	41	43	45	46								
	24	34	43	45	47	49	52							
	30	42	49	50	52	54	57	62						
	36	50	54	56	58	60	62	67	73					
	42	57	59	61	63	65	67	72	78	83				
	48	64	64	66	68	70	73	78	83	88	94			
	54	72	71	73	75	77	79	85	90	95	100	107		
	60	78	77	79	81	83	85	90	96	101	106	113	119	
	66	86	86	88	90	92	94	100	105	110	115	122	128	137

MH Dia	Allowable Angle													
	Pipe ID	(inches)	12	15	18	24	30	36	42	48	54	60	66	72
	Opening		21	24	27	34	42	50	57	64	72	78	86	94
108	12	21	31											
	15	24	33	35										
	18	27	35	36	38									
	24	34	39	40	42	46								
	30	42	43	45	46	50	55							
	36	50	48	49	51	55	59	64						
	42	57	52	54	55	59	64	68	73					
	48	64	57	58	60	64	68	73	77	82				
	54	72	62	64	65	69	74	78	83	87	93			
	60	78	66	68	70	74	78	83	87	92	97	101		
	66	86	73	75	76	80	85	89	94	98	104	108	115	
	72	94	81	82	84	88	92	97	101	106	111	116	122	130

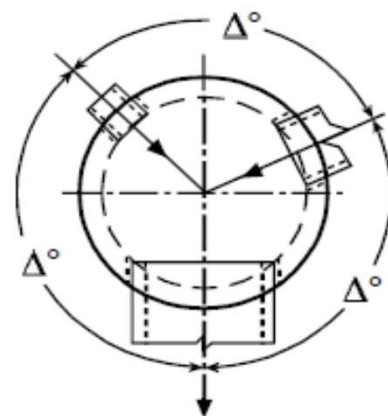
Equations:

$$A_o = \text{asin} (O_{po} / ID_m)$$

$$A_i = \text{asin} (O_{pi} / ID_m)$$

$$A_c = \text{Clear Cir} / ID_m / \pi \times 360$$

$$\text{MinAng} = A_o + A_i + A_c$$



Notes:

Allowable angles shown based upon Concrete Pipe to be grouted straight into openings in field with 6" clear for 48" - 72" manholes and 8" clear for 84" - 126" manholes with matching centerlines. Vertical separation may allow smaller angles. Local jurisdictions may require larger angles between pipe openings or larger manholes than shown.

Allowable Angles in Round Manholes for Concrete Pipe using Grouted Connections

MH Dia	Allowable Angle													
	Pipe ID	(inches)	12	15	18	24	30	36	42	48	54	60	66	72
	Opening		21	24	27	34	42	50	57	64	72	78	86	94
120	12	21	28											
	15	24	30	31										
	18	27	31	33	34									
	24	34	35	36	38	41								
	30	42	39	40	42	45	49							
	36	50	43	44	46	49	53	57						
	42	57	47	48	50	53	57	61	65					
	48	64	50	52	53	57	61	65	69	73				
	54	72	55	57	58	61	65	70	73	77	82			
	60	78	59	60	62	65	69	73	77	81	86	89		
	66	86	64	65	67	70	74	79	82	86	91	94	100	
	72	94	70	71	73	76	80	84	88	92	97	100	105	111

MH Dia	Allowable Angle													
	Pipe ID	(inches)	12	15	18	24	30	36	42	48	54	60	66	72
	Opening		21	24	27	34	42	50	57	64	72	78	86	94
126	12	21	27											
	15	24	28	30										
	18	27	30	31	33									
	24	34	33	34	36	39								
	30	42	37	38	40	43	47							
	36	50	41	42	44	47	51	55						
	42	57	44	46	47	50	54	58	62					
	48	64	48	49	51	54	58	62	65	69				
	54	72	52	54	55	58	62	66	70	73	77			
	60	78	56	57	58	62	65	69	73	77	81	84		
	66	86	60	62	63	66	70	74	78	81	86	89	94	
	72	94	66	67	68	72	75	79	83	87	91	94	99	104

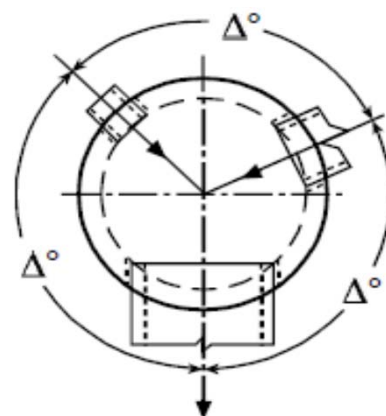
Equations:

$$A_o = \text{asin} (O_{po} / ID_m)$$

$$A_i = \text{asin} (O_{pi} / ID_m)$$

$$A_c = \text{Clear Cir} / ID_m / \pi \times 360$$

$$\text{MinAng} = A_o + A_i + A_c$$



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