

## A Study on the Selecting Model of Maintenance Methodology for Establishing the Optimized Maintenance Policy of Facilities

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### A b s t r a c t

The purpose of this research is to present the new proposal models for the selection and application of optimizing maintenance method in the equipment maintenance business. First, as the theoretical background for the selection and application of optimizing maintenance method, the maintenance methods and countermeasures based on the types of failure rate by the already informed bathtub curve were presented. And second, the purpose of this research is to help the apprehension about the selection and application of maintenance by the investigation on the pros and cons of application about three types of maintenance ways such as BM, TBM, CBM. And finally, as the two new proposal models for the selection and application of the optimizing maintenance method in the equipment maintenance, this treatise presented the 「selection model of maintenance way based on the important degree of equipment」 and 「selection model of maintenance way based on the reliability and total cost」. These two new proposal models are going to permit the easy application and fast selection for the selection and application of maintenance way and on-the-job maintenance business.

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가

가

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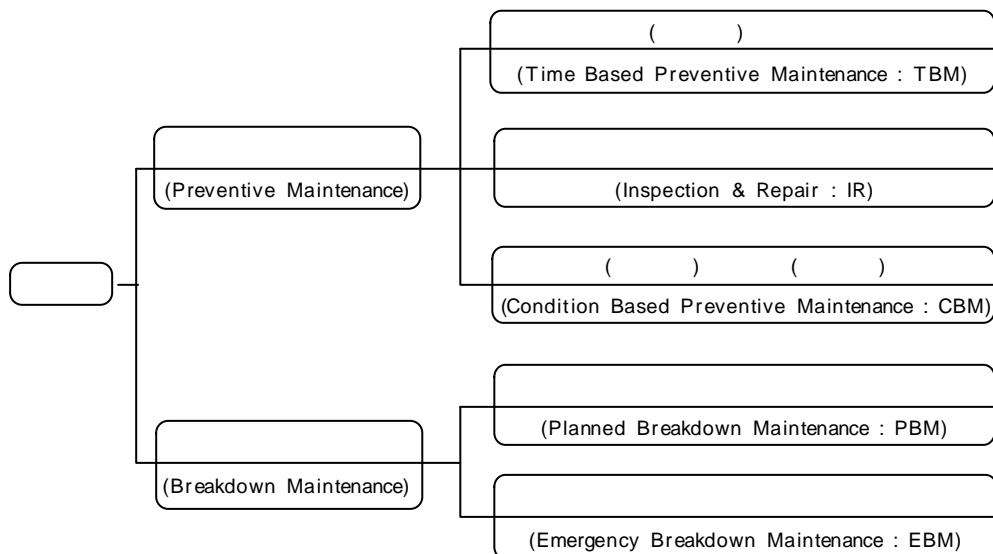
BM, TBM, CBM

가  
2가 P(Products), Q(Quality),  
C(Cost), D(Delivery & Damage), S(Safety) 가 (A, B, C,  
D )  
가  
가

2.

2.1

< 1> 가 (Preventive  
Maintenance : PM) (Breakdown Maintenance : BM) 2가  
[1]. (Time Based Preventive  
Maintenance : TBM), (Inspection & Repair : IR),  
(Condition Based Preventive Maintenance : CBM) , (BM)  
(Planned Breakdown Maintenance : PBM) (Emergency Breakdown  
Maintenance : EBM) [2][3].



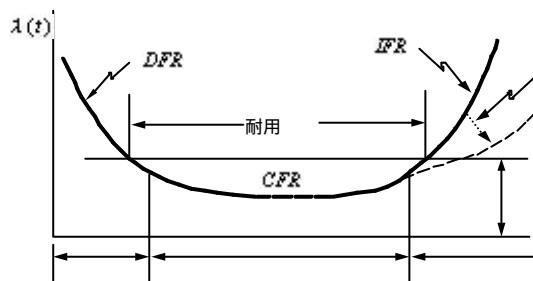
< 1>

(EBM) 4가 ,  
(PM) (BM)  
[1].  
TBM, IR, CBM, BM 가

## 2.2

### 2.2.1

가 가 <  
2> (bath-tub curve) [5][6].  
3가 DFR(Decreasing Failure Rate), CFR(Constant Failure Rate),  
IFR(Increasing Failure Rate)



< 2> (Bath-tub)

(debugging )  
DFR  
CFR 耐用 (longevity) ,  $I(t)$  가  
 $R(t)$  ,  $R(t) = e^{-I t}$  가  
 $I$  ( )  
가 IFR 가



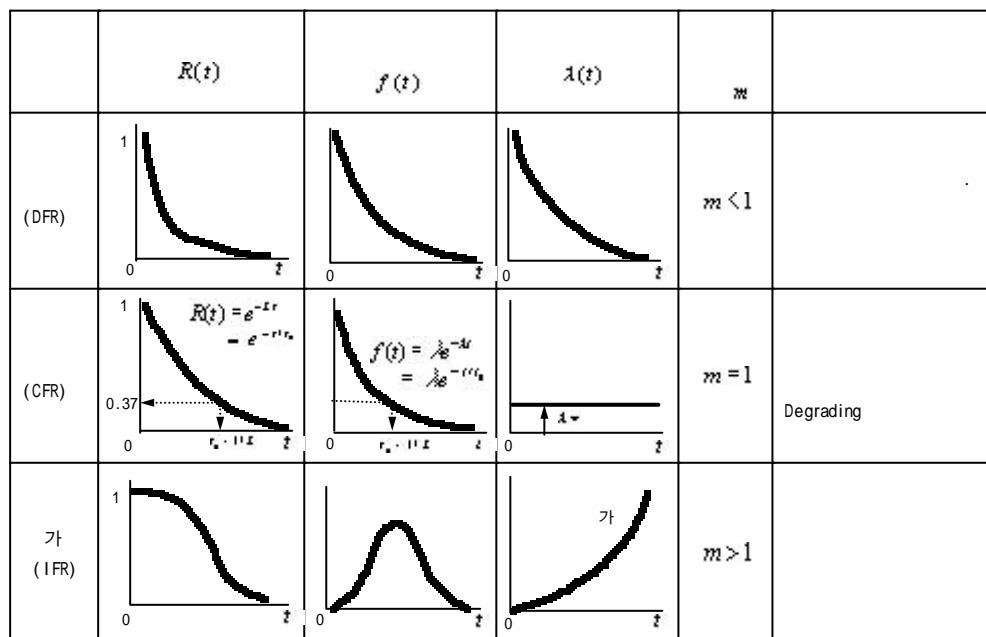
$$I(t) = \frac{f(t)}{R(t)} = \frac{m}{h} \left[ \frac{t-g}{h} \right]^{m-1} \quad (7)$$

$m < 1$   $I(t)$  (DFR)  
 $m = 1$   $I(t)$  (CFR)  $f(t)$   
 $m > 1$   $I(t)$  가 (IFR) ,  $f(t)$   
 $(m = 3.5)$

### 2.2.3

$I(t)$  (DFR), (CFR), 가 (IFR) 3 가  
 (pattern)  
 $< 1 >$  [4].

$< 1 >$   $I(t)$   $f(t)$



debugging

, (extreme condition)

, (safety margin)

degrading

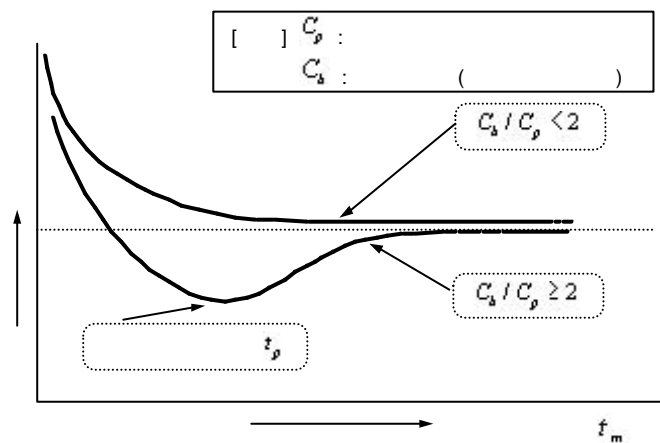
(PM)

가

## 2.3

### 2.3.1 (BM)

(BM) 가  
 . BM  
 (PBM) 「  
 (EBM) . PBM EBM  
 . EBM  
 0( ) , PBM [9].  
 PBM  
 $t_m$  가 (=  $C_p + C_b$  [1].  
 ])  $C_b / C_p$  < 3 >  $C_b / C_p$



< 3> (TBM)

$C_b / C_p \geq 2$   $t_p$  가  
 $C_b / C_p < 2$   $t_p$   
 , (TBM) 가 ,  
 $t_p = \infty$  가 「  
 ( + )  $C_b$  가  $C_p$  2  
 (PBM) . 가 (8)  
 [1].  
 $C_b \geq 2C_p$  (8)  
 $C_b$  : ( + )  
 $C_p$  :

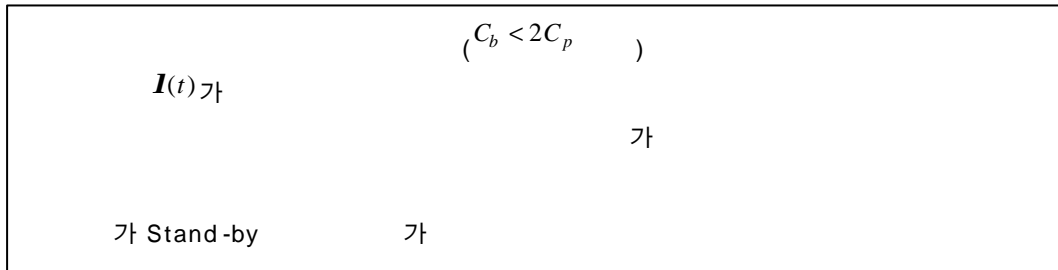
(8)

가

가

(PBM)

[1] - [3].



2.3.2

(TBM)

PM

가

$I(t)$ 가

가

IFR(Increasing  
Bath - tub

Failure Rate)

(TBM)

(TBM)

$I(t)$

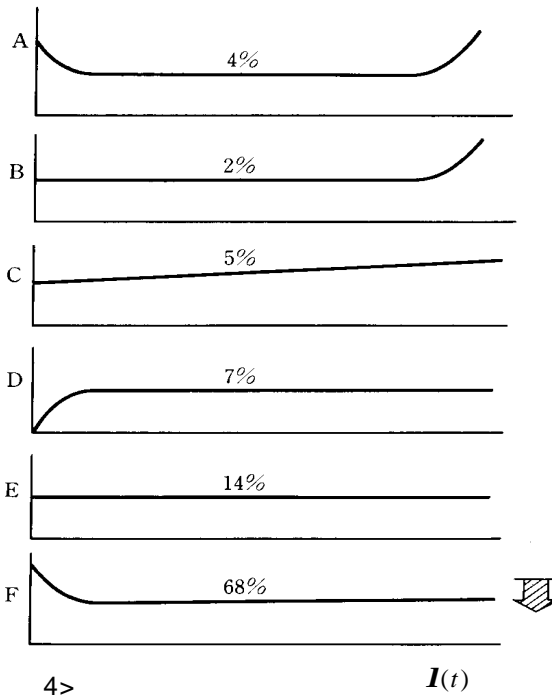
$I(t)$ 가

가

IFR

10%

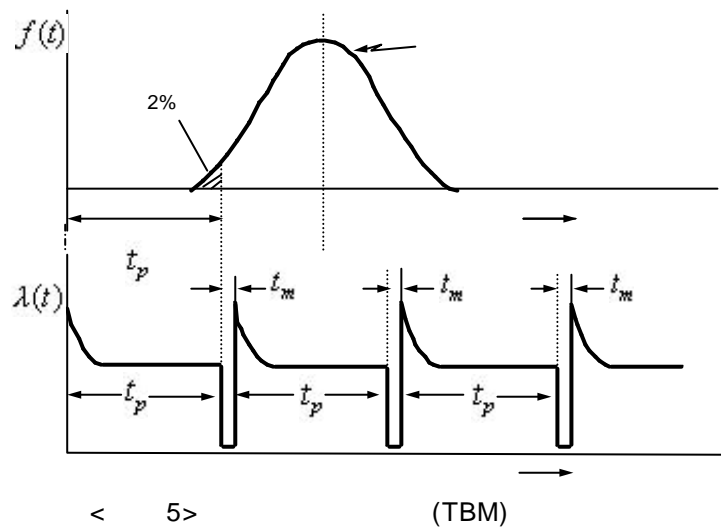
[1].



< 4> 가  $I(t)$   
 $I(t)$  가 가 A(4%),  
 B(2%), C(5%) 11% ,  $I(t)$  가 D(7%), E(14%),  
 F(68%) 89%  $I(t)$   
 TBM

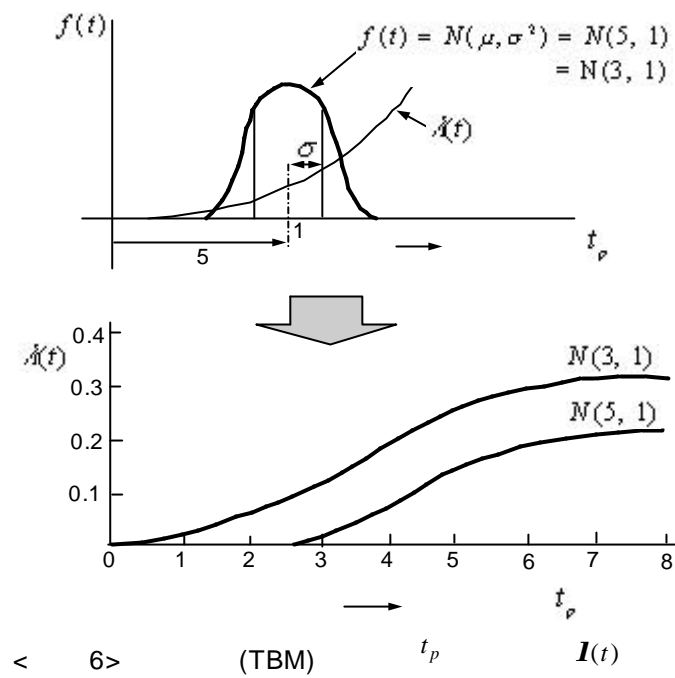
< 5> TBM  $I(t)$   $f(t)$   
 (TBM) 2%가  
 [2]. 2%  
 ( 가 )  
 가 가  $I(t)$ 가  
 , 98%

TBM



(TBM)  $I(t)$   
 $m$   $s$  3  
 $f(t)$ 가  $N(ms^2)$  ,  $N(ms^2) = N(5,1)$   
 ( $m=5$ )  $3s$  ( $s=1$ )  $t=2$   
 $I(t)=0$





(TBM)  $I(t)$  0

(9) [1].

$$t_p \leq m - 3s \quad (9)$$

,  $t_p$  :  
 $m$  :  
 $s$  :

(9)  $t_p$  가 .  
 (TBM) 가 . TBM  
 [1] - [3] [10].

$t_p$  가 가 .  
 ( 가 ) . 10%  
 가 (Availability) .

TBM  
 (CBM) .

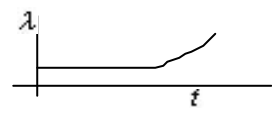
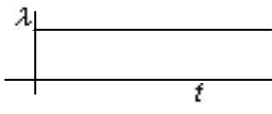

### 2.3.3 (CBM)

TBM  
, TBM (CBM)  
(Predictive Maintenance)  
(British Standard) CBM [1].

Maintenance carried out in response to a significant deterioration in a machine as indicated by a change in a monitored parameter of the machine condition.

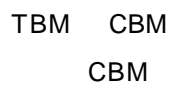
「CBM  
」 「 (in response to) 」  
, 「  
」 「 ( )가  
」  
CBM CBM 「Leave the smoothly running  
machines untouched(가  
」CBM (machine condition)  
」가 CBM 「  
( ) 」

< 2>

		BM	TBM	CBM
가 (IFR)		x		
(CFR)			x	
(DFR)		x	x	

1. : , : , x : ,

2. BM : , TBM : , CBM :

$$\langle 7 \rangle_{\text{CBM}} = \frac{1}{N} \sum_{i=1}^N t_i, \quad t_p$$


[1].

가

### 3.1

가 가 . ,

(P)	가		4	3	2	1	가			
	1. 가		4	3	2	1	4 : 90%		3 : 80%	
	2.		4	3	2	1	2 : 70%		1 : 70%	
	3. 가 (Time/Time)			4	3	1	4 : Tact Time		3 : Tact Time	
(Q)	4.			4	3	1	4 : 3 :		1 : Tact Time	
	5.		4	3	2	1	4 : 3 :		2 : 1 :	
C)	6.		4	3	2	1	4 : S/V		3 : S/V	
	7. (MTTR)			4	3	1	2 : 1 :		가	
	8. ( )		5	3	2	1	4 : 3 Hr		3 : 1 Hr	
(D)	9.		4	3	2	1	1 : 1 Hr		5 : 3 :	
(S)	10.			4	2	1	2 : 1		3 : 1	
	11.		5	4	3	1	4 : 2 :		5 : 4 :	
	12.		4	3	2	1	3 : Line		: 3	
	= 가 × 100						1 : : 1		4 : 3	
						4 : 10		3 : 3		
						2 : 3		1 : 3		
						90		80~90		
						A		B		
						70~80		70		
						C		D		

가, 가

12

P : Products, ( )

Q : Quality,

C : Cost, 가

D : Delivery & Damage,

S : Safety,

가 < 3> 가 ,  
가 (A , B , C , D  
) , < 3> 가

. 가  
, 가  
< 4>

, 가

< 4>

	가		
A	90	* Line * Back-up 가 * *	* ( , TBM, IR, CBM) * ( , , ) * * ( , MTBF, MTTR)
B	80~90	* 가 *	* ( , TBM, IR, CBM) * ( , , )
C	70~80	* Back-up 가 Line	* (BM)
D	70	* Line *	* (BM)

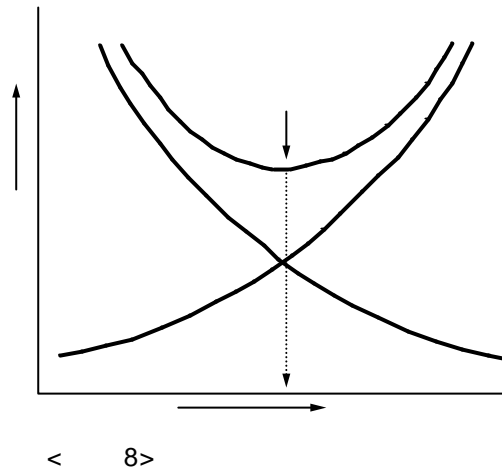
< 5>

< 5>

	“ ( ) ” 가
	.
	, TBM, IR, CBM
	, ( , )

### 3.2

[12].



가

[12],

가

TBM

IR

가 ,

CBM

가 ,

가 .

BM

, 가 .

(TBM, IR, CBM, BM)

가

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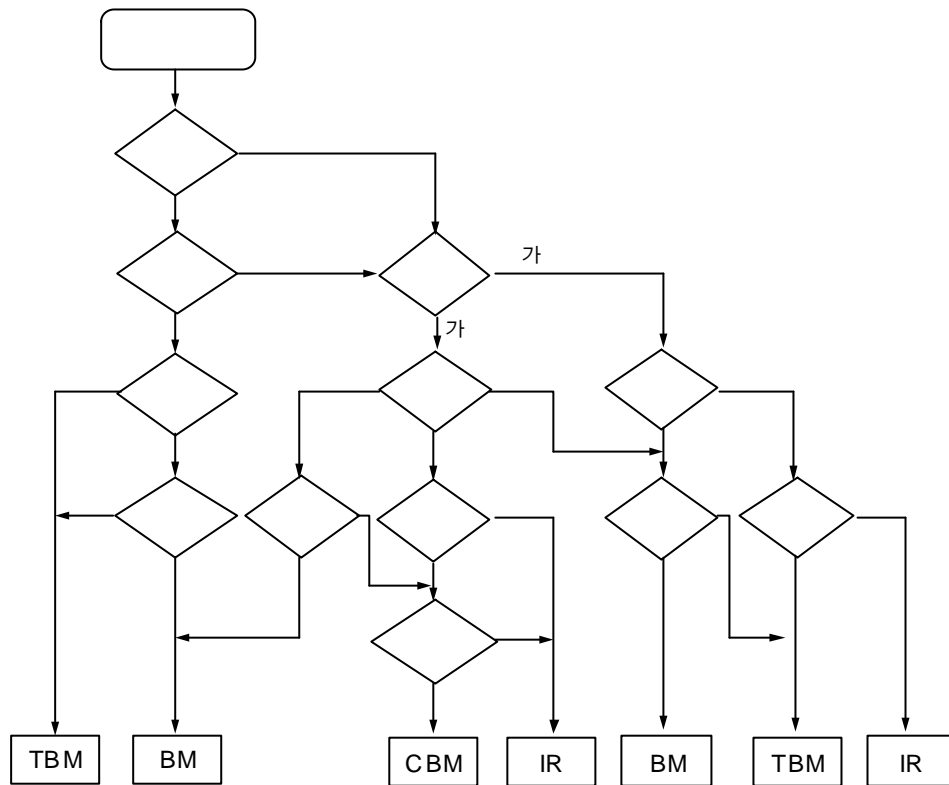
가

가

6

<

9>



< 9>

가

TBM, IR, CBM, BM

< 9>

6

가

가

CM

가





가

(TBM, IR, CBM, BM)

「 」

Fuzzy

가 . Fuzzy

가

[1].

가

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