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L A M P I R A N

Lampiran 1 Tabel FMEA

no	item	fungsi	potensi kegagalan dan penyebab	akibat dari kerusakan			metode untuk mengetahui kerusakan	s	o	d	rpn
				pada sistem	efek lanjutan	efek akhir					
1	tangki induk	tempat penyimpanan utama dari minyak pelumas	kebocoran pada tangki	oli masuk ke bilga dan oli bercampur dengan air	tidak terjadi pelumasan pada mesin	terjadi kerusakan pada komponen sistem pelumasan mesin	pengecekan manual	3	1	1	3
2	*oil pan*	tempat menampung minyak pelumas yang bersikulasi	kebocoran	oli tidak bersikulasi dengan baik akibat kebocoran	komponen pelumas pada mesin akan aus akibat gesekan karena tidak adanya oli	terjadi cacat komponen	pengecekan manual	2	1	5	10
3	*oil pump*	memindahkan fluida minyak untuk dinaikkan ke seluruh komponen mesin	seal bocor dan tekanan menurun sampai 3 bar	komponen tidak terlumasi dengan baik	komponen pada mesin bisa aus	mesin bisa ngejim	di cek pada panel control	8	2	1	16
4	*oil filter*	untuk menyaring minyak pelumas dari kotora seperti debu, serpihan logam dan oksida	cepat kotor dan cepat buntu	penyaringan partikel kotoran tidak berjalan dengan baik	kotoran-kotoran oli bekas masuk kedalam mesin sehingga mengganggu kinerja mesin	mesin bisa ngejim	membuka cover filter	8	4	1	32
5	*regulator valve*	untuk mengatur besarnya tekanan pada system pelumasan.	oli yang keluar berkurang	komponen tidak bisa terlumasi dengan baik	mesin menjadi aus	engine down	pengecekan manual atau mengecek pada panel engine	8	1	1	8
6	*oil pressure valve*	untuk mendeteksi tekanan minyak pelumas yang keluar dari pompa.	sensore tidak mendeteksi besarnya tekanan	mesin tidak melumasi keseluruhan komponen	mesin menjadi aus	engine down	pengecekan pada panel kontrol	5	2	1	10
7	*cooler*	untuk menurunkan temperature minyak pelumas	terjadi kebocoran	oli bercampur dengan air	oli masuk ke radiator	mesin mati dan overheat	pengecekan pada radiator	8	1	5	40

A. Perhitungan Biaya Preventive Maintenance Policy yang Diperkirakan

Untuk menghitung biaya *preventive maintenance* yang diperkirakan mengikuti langkah-langkah sebagai berikut

a. Kumulatif Jumlah *Breakdown* dalam n Periode Operasi oil pump (pengerjaan mekanik)

$$B_1 = N * p1$$
$$= 1 * 0{,}059$$
$$= 0{,}059$$
$$B_2 = N(p1 + p2) + B_1 p1$$
$$= 1(0{,}059 + 0{,}088) + (0{,}059 * 0{,}059)$$
$$= 0{,}151$$
$$B_3 = N(p1 + p2 + p3) + B_1 p1 + B_2 p2$$
$$= 1(0{,}059 + 0{,}088 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088)$$
$$= 0{,}223$$
$$B_4 = N(p1 + p2 + p3 + p4) + B_1 p1 + B_2 p2 + B_3 p3$$
$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) +$$
$$(0{,}151 * 0{,}088) + (0{,}223 * 0{,}059)$$
$$= 0{,}353$$
$$B_5 = N(p1 + p2 + p3 + p4 + p5) + B_1 p1 + B_2 p2 + B_3 p3 + B_4 p4$$
$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059)$$
$$+ (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059)$$
$$= 0{,}483$$
$$B_6 = N(p1 + p2 + p3 + p4 + p5 + p6) + B_1 p1 + B_2 p2 + B_3 p3$$
$$+ B_4 p4 + B_5 p5$$
$$= 2(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059)$$
$$+ (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059)$$
$$+ (0{,}483 * 0{,}088)$$
$$= 0{,}585$$
$$B_7 = N(p1 + p2 + p3 + p4 + p5 + p6 + p7) + B_1 p1 + B_2 p2 + B_3 p3$$
$$+ B_4 p4 + B_5 p5 + B_6 p6$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059) + (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059)$$

$$= 0{,}678$$

$$B_8 = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059) + (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059) + (0{,}678 * 0{,}059)$$

$$= 0{,}835$$

$$B_9 = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059) + (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059) + (0{,}678 * 0{,}059) + (0{,}835 * 0{,}059)$$

$$= 1{,}022$$

$$B_{10} = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059) + (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059) + (0{,}678 * 0{,}059) + (0{,}835 * 0{,}059) + (1{,}022 * 0{,}088)$$

$$= 1{,}230$$

$$B_{11} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9 + B_{10}p10$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059) + (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059) + (0{,}678 * 0{,}059) + (0{,}835 * 0{,}059) + (1{,}022 * 0{,}088) + (1{,}230 * 0{,}059)$$

$$= 1{,}433$$

$$B_{12} = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9 + B_{10}p10 + B_{11}p11$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059) + (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059) + (0{,}678 * 0{,}059) + (0{,}835 * 0{,}059) + (1{,}022 * 0{,}088) + (1{,}230 * 0{,}059) + (1{,}433 * 0{,}059)$$

$$= 1{,}606$$

b. Rata-Rata Jumlah Breakdown dalam n Periode Operasi

$$B = \frac{Bn}{n}$$

- **Oil pump**

➢ $B = \frac{0{,}059}{1}$

$= 0{,}059$

➢ $B = \frac{0{,}151}{2}$

$= 0{,}075$

➢ $B = \frac{0{,}223}{3}$

$= 0{,}074$

➢ $B = \frac{0{,}353}{4}$

$= 0{,}088$

➢ $B = \frac{0{,}483}{5}$

$= 0{,}097$

- $B = \frac{0,585}{6}$
  $= 0,097$
- $B = \frac{0,678}{7}$
  $= 0,097$
- $B = \frac{0,835}{8}$
  $= 0,104$
- $B = \frac{1,022}{9}$
  $= 0,114$
- $B = \frac{1,230}{10}$
  $= 0,123$
- $B = \frac{1,433}{11}$
  $= 0,130$
- $B = \frac{1,606}{12}$
  $= 0,134$

c. Perkiraan Biaya Repair per n Periode Operasi

$TCr = B * Cr$

- **Oil pump**

- $TCr_1 = 0,059 * Rp\ 88.705.072$
  $= Rp\ 2.680.588,235$
- $TCr_2 = 0,151 * Rp\ 88.705.072$
  $= Rp\ 3.429.576,125$
- $TCr_3 = 0,088 * Rp\ 88.705.072$
  $= Rp\ 3.381.653$
- $TCr_4 = 0,059 * Rp\ 88.705.072$
  $= Rp\ 4.025.725$

- $TCr_5 = 0{,}097 * Rp\ 88.705.072$
  $= Rp\ 4.403.648$
- $TCr_6 = 0{,}097 * Rp\ 88.705.072$
  $= Rp\ 4.440.269$
- $TCr_7 = 0{,}097 * Rp\ 88.705.072$
  $= Rp\ 4.412.765$
- $TCr_8 = 0{,}104 * Rp\ 88.705.072$
  $= Rp\ 4.758.444$
- $TCr_9 = 0{,}114 * Rp\ 88.705.072$
  $= Rp\ 5.174.108$
- $TCr_{10} = 0{,}123 * Rp\ 88.705.072$
  $= Rp\ 5.603.700$
- $TCr_{11} = 0{,}130 * Rp\ 88.705.072$
  $= Rp\ 5.937.289$
- $TCr_{12} = 0{,}134 * Rp\ 88.705.072$
  $= Rp\ 6.097.736$

d. **Biaya Preventive Maintanance per n Periode**

$$TCm_1 = \frac{N * Cm}{n}$$

- **Oil pump**
  - $TCm_1 = \frac{1 * Rp\ 4.180.000}{1}$
    $= Rp\ 4.180.000$
  - $TCm_2 = \frac{1 * Rp\ 4.180.000}{2}$
    $= Rp\ 2.090.000$
  - $TCm_3 = \frac{1 * Rp\ 4.180.000}{3}$
    $= Rp\ 1.393.333$
  - $TCm_4 = \frac{1 * Rp\ 4.180.000}{4}$
    $= Rp\ 1.045.000$

- $TCm_{5} = \frac{1 * Rp\ 4.180.000}{5}$

  $= Rp\ 836.000$

- $TCm_{6} = \frac{1 * Rp\ 4.180.000}{6}$

  $= Rp\ 696.667$

- $TCm_{7} = \frac{1 * Rp\ 4.180.000}{7}$

  $= Rp\ 597.143$

- $TCm_{8} = \frac{1 * Rp\ 4.180.000}{8}$

  $= Rp\ 522.500$

- $TCm_{9} = \frac{1 * Rp\ 4.180.000}{9}$

  $= Rp\ 464.444$

- $TCm_{10} = \frac{1 * Rp\ 4.180.000}{10}$

  $= Rp\ 418.000$

- $TCm_{11} = \frac{1 * Rp\ 4.180.000}{11}$

  $= Rp\ 380.000$

- $TCm_{12} = \frac{1 * Rp\ 4.180.000}{12}$

  $= Rp\ 348.333$

e. **Total Biaya Maintenance per n Bulan Operasi**

$TMC(n) = TCr(n) + TCm(n)$

- *Oil pump*

- $TMC(1) = Rp\ 2.680.588{,}235 + Rp\ 4.180.000$

  $= Rp\ 6.860.588$

- $TMC(2) = Rp\ 3.429.576{,}125 + Rp\ 2.090.000$

  $= Rp\ 5.519.576$

- $TMC(3) = Rp\ 32.273 + Rp\ 1.393.333$
  $= Rp\ 4.774.986$
- $TMC(4) = Rp\ 4.025.725 + Rp\ 1.045.000$
  $= Rp\ 5.070.724$
- $TMC(5) = Rp\ 4.403.648 + Rp\ 836.000$
  $= Rp\ 5.239.647$
- $TMC(6) = Rp\ 4.440.269 + Rp\ 696.667$
  $= Rp\ 5.136.935{,}618$
- $TMC(7) = Rp\ 4.412.765 + Rp\ 597.143$
  $= Rp\ 5.009.908$
- $TMC(8) = Rp\ 4.758.444 + Rp\ 522.500$
  $= Rp\ 5.280.944$
- $TMC(9) = Rp\ 5.174.108 + Rp\ 464.444$
  $= Rp 5.638.552$
- $TMC(10) = Rp\ 5.603.700 + Rp\ 418.000$
  $= Rp\ 6.021.700$
- $TMC(11) = Rp\ 5.937.289 + Rp\ 380.000$
  $= Rp\ 6.317.289$
- $TMC(12) = Rp\ 6.097.736 + Rp\ 348.333$
  $= Rp\ 6.446.069$

a. Kumulatif Jumlah *Breakdown* dalam n Periode Operasi oil pump (pengerjaan crew kapal)

$B_1 = N * p1$
$= 1 * 0{,}059$
$= 0{,}059$

$B_2 = N(p1 + p2) + B_1 p1$
$= 1(0{,}059 + 0{,}088) + (0{,}059 * 0{,}059)$
$= 0{,}151$

$B_3 = N(p1 + p2 + p3) + B_1 p1 + B_2 p2$
$= 1(0{,}059 + 0{,}088 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088)$

$$= 0{,}223$$

$$B_4 = N(p1 + p2 + p3 + p4) + B_1p1 + B_2p2 + B_3p3$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) +$$

$$(0{,}151 * 0{,}088) + (0{,}223 * 0{,}059)$$

$$= 0{,}353$$

$$B_5 = N(p1 + p2 + p3 + p4 + p5) + B_1p1 + B_2p2 + B_3p3 + B_4p4$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059)$$
$$+ (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059)$$

$$= 0{,}483$$

$$B_6 = N(p1 + p2 + p3 + p4 + p5 + p6) + B_1p1 + B_2p2 + B_3p3$$
$$+ B_4p4 + B_5p5$$

$$= 2(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059)$$
$$+ (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059)$$
$$+ (0{,}483 * 0{,}088)$$

$$= 0{,}585$$

$$B_7 = N(p1 + p2 + p3 + p4 + p5 + p6 + p7) + B_1p1 + B_2p2 + B_3p3$$
$$+ B_4p4 + B_5p5 + B_6p6$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059)$$
$$+ (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059)$$
$$+ (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059)$$

$$= 0{,}678$$

$$B_8 = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8) + B_1p1 + B_2p2$$
$$+ B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059)$$
$$+ (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059)$$
$$+ (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059) + (0{,}678 * 0{,}059)$$

$$= 0{,}835$$

$$B_9 = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9) + B_1p1$$
$$+ B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059) + (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059) + (0{,}678 * 0{,}059) + (0{,}835 * 0{,}059)$$

$$= 1{,}022$$

$$B_{10} = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9) + B_1 p1 + B_2 p2 + B_3 p3 + B_4 p4 + B_5 p5 + B_6 p6 + B_7 p7 + B_8 p8 + B_9 p9$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059) + (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059) + (0{,}678 * 0{,}059) + (0{,}835 * 0{,}059) + (1{,}022 * 0{,}088)$$

$$= 1{,}230$$

$$B_{11} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11) + B_1 p1 + B_2 p2 + B_3 p3 + B_4 p4 + B_5 p5 + B_6 p6 + B_7 p7 + B_8 p8 + B_9 p9 + B_{10} p10$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059) + (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059) + (0{,}678 * 0{,}059) + (0{,}835 * 0{,}059) + (1{,}022 * 0{,}088) + (1{,}230 * 0{,}059)$$

$$= 1{,}433$$

$$B_{12} = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11) + B_1 p1 + B_2 p2 + B_3 p3 + B_4 p4 + B_5 p5 + B_6 p6 + B_7 p7 + B_8 p8 + B_9 p9 + B_{10} p10 + B_{11} p11$$

$$= 1(0{,}059 + 0{,}088 + 0{,}059 + 0{,}059) + (0{,}059 * 0{,}059) + (0{,}151 * 0{,}088) + (0{,}223 * 0{,}059) + (0{,}353 + 0{,}059) + (0{,}483 * 0{,}088) + (0{,}585 * 0{,}059) + (0{,}678 * 0{,}059) + (0{,}835 * 0{,}059) + (1{,}022 * 0{,}088) + (1{,}230 * 0{,}059) + (1{,}433 * 0{,}059)$$

$$= 1{,}606$$

b. Rata-Rata Jumlah Breakdown dalam n Periode Operasi

$$B = \frac{Bn}{n}$$

- **Oil pump**

➢ $B = \frac{0,059}{1}$

$= 0,059$

➢ $B = \frac{0,151}{2}$

$= 0,075$

➢ $B = \frac{0,223}{3}$

$= 0,074$

➢ $B = \frac{0,353}{4}$

$= 0,088$

➢ $B = \frac{0,483}{5}$

$= 0,097$

➢ $B = \frac{0,585}{6}$

$= 0,097$

➢ $B = \frac{0,678}{7}$

$= 0,097$

➢ $B = \frac{0,835}{8}$

$= 0,104$

➢ $B = \frac{1,022}{9}$

$= 0,114$

➢ $B = \frac{1,230}{10}$

$= 0,123$

- $B = \frac{1,433}{11}$
  $= 0,130$
- $B = \frac{1,606}{12}$
  $= 0,134$

c. Perkiraan Biaya Repair per n Periode Operasi

$TCr = B * Cr$

- **Oil pump**

- $TCr_1 = 0,059 * Rp\ 88.705.072$
  $= Rp\ 5.217.945$
- $TCr_2 = 0,151 * Rp\ 88.705.072$
  $= Rp\ 6.675.901$
- $TCr_3 = 0,088 * Rp\ 88.705.072$
  $= Rp\ 6.582.616$
- $TCr_4 = 0,059 * Rp\ 88.705.072$
  $= Rp\ 7.836.344$
- $TCr_5 = 0,097 * Rp\ 88.705.072$
  $= Rp\ 8.571.997$
- $TCr_6 = 0,097 * Rp\ 88.705.072$
  $= Rp\ 8.643.282$
- $TCr_7 = 0,097 * Rp\ 88.705.072$
  $= Rp 8.589.744$
- $TCr_8 = 0,104 * Rp\ 88.705.072$
  $= Rp\ 9.262.632$
- $TCr_9 = 0,114 * Rp\ 88.705.072$
  $= Rp\ 10.071.749$
- $TCr_{10} = 0,123 * Rp\ 88.705.072$
  $= Rp\ 10.907.979$
- $TCr_{11} = 0,130 * Rp\ 88.705.072$
  $= Rp\ 11.557.332$

- $TCr_{12} = 0{,}134 * Rp\ 88.705.072$

  $= Rp\ 11.869.653$

d. **Biaya Preventive Maintanance per n Periode**

$$TCm_1 = \frac{N * Cm}{n}$$

- **Oil pump**

- $TCm_1 = \frac{1 * Rp\ 76.765.072}{1}$

  $= Rp\ 76.765.072$

- $TCm_2 = \frac{1 * Rp\ 76.765.072}{2}$

  $= Rp\ 38.382.536$

- $TCm_3 = \frac{1 * Rp\ 76.765.072}{3}$

  $= Rp\ 25.588.357$

- $TCm_4 = \frac{1 * Rp\ 76.765.072}{4}$

  $= Rp\ 19.191.268$

- $TCm_5 = \frac{1 * Rp\ 76.765.072}{5}$

  $= Rp\ 15.353.014$

- $TCm_6 = \frac{1 * Rp\ 76.765.072}{6}$

  $= Rp\ 12.794.179$

- $TCm_7 = \frac{1 * Rp\ 76.765.072}{7}$

  $= Rp\ 10.966.439$

- $TCm_8 = \frac{1 * Rp\ 76.765.072}{8}$

  $= Rp\ 9.595.634$

- $TCm_9 = \frac{1 * Rp\ 76.765.072}{9}$

$= Rp\ 8.529.452$

- $TCm_{10} = \frac{1 * Rp\ 76.765.072}{10}$

  $= Rp\ 7.676.507$

- $TCm_{11} = \frac{1 * Rp\ 76.765.072}{11}$

  $= Rp\ 6.978.643$

- $TCm_{12} = \frac{1 * Rp\ 76.765.072}{12}$

  $= Rp\ 6.397.089$

e. **Total Biaya Maintenance per n Bulan Operasi**

$TMC(n) = TCr(n) + TCm(n)$

- *Oil pump*

- $TMC(1) = Rp\ 5.217.945 + Rp\ 76.765.072$

  $= Rp\ 81.983.017$
- $TMC(2) = Rp\ 6.675.901 + Rp\ 38.382.536$

  $= Rp45.058.437$
- $TMC(3) = Rp6.582.616 + Rp\ 25.588.357$

  $= Rp\ 32.170.973$
- $TMC(4) = Rp\ 7.836.344 + Rp\ 19.191.268$

  $= Rp\ 27.027.612$
- $TMC(5) = Rp\ 8.571.997 + Rp\ 15.353.014$

  $= Rp\ 23.925.011$
- $TMC(6) = Rp\ 8.643.282 + Rp\ 12.794.179$

  $= Rp\ 21.437.461$
- $TMC(7) = Rp8.589.744 + Rp\ 10.966.439$

  $= Rp\ 19.556.183$
- $TMC(8) = Rp\ 9.262.632 + Rp\ 9.595.634$

  $= Rp\ 18.858.266$
- $TMC(9) = Rp\ 10.071.749 + Rp\ 8.529.452$

$= Rp18.601.202$

- $TMC(10) = Rp\ 10.907.979 + Rp\ 7.676.507$
  $= Rp\ 18.584.486$
- $TMC(11) = Rp\ 11.557.332 + Rp\ 6.978.643$
  $= Rp\ 18.535.975$
- $TMC(12) = Rp\ 11.869.653 + Rp\ 6.397.089$
  $= Rp\ 18.266.743$

Oil cooler

a. Kumulatif Jumlah *Breakdown* dalam n Periode Operasi oil cooler (pengerjaan mekanik)

$B_1 = N * p1$
$= 1 * 0{,}071$
$= 0{,}071$

$B_2 = N(p1 + p2) + B_1 p1$
$= 1(0{,}071 + 0{,}094) + (0{,}071 * 0{,}071)$
$= 0{,}172$

$B_3 = N(p1 + p2 + p3) + B_1 p1 + B_2 p2$
$= 1(0{,}071 + 0{,}094 + 0{,}071) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094)$
$= 0{,}260$

$B_4 = 1(p1 + p2 + p3 + p4) + B_1 p1 + B_2 p2 + B_3 p3$
$= 1(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119) + (0{,}071 * 0{,}071) +$
$(0{,}172 * 0{,}094) + (0{,}260 * 0{,}071)$
$= 0{,}397$

$B_5 = 1(p1 + p2 + p3 + p4 + p5) + B_1 p1 + B_2 p2 + B_3 p3 + B_4 p4$
$= 2(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119) + (0{,}071 * 0{,}071)$
$+ (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119)$
$= 0{,}492$

$B_6 = 1(p1 + p2 + p3 + p4 + p5 + p6) + B_1 p1 + B_2 p2 + B_3 p3 + B_4 p4$
$+ B_5 p5$

$$= 1(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048)$$

$$= 0{,}611$$

$$B_7 = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6$$

$$= 2(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094)$$

$$= 0{,}740$$

$$B_8 = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7$$

$$= 2(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094) + (0{,}740 * 0{,}071)$$

$$= 0{,}888$$

$$B_9 = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8$$

$$= 1\,(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071 + 0{,}094) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094) + (0{,}740 * 0{,}071) + (0{,}888 * 0{,}094)$$

$$= 1{,}044$$

$$B_{10} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9$$

$$= 1(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071 + 0{,}094 + 0{,}071 + 0{,}119) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094) + (0{,}740 * 0{,}071) + (0{,}888 * 0{,}094) + (1{,}044 * 0{,}071)$$

$$= 1{,}238$$

$$B_{11} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9 + B_{10}p10$$

$$= 1(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}094) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094) + (0{,}740 * 0{,}071) + (0{,}888 * 0{,}094) + (1{,}044 * 0{,}071) + (1{,}238 * 0{,}094)$$

$$= 1{,}481$$

$$B_{12} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11 + p12) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9 + B_{10}p10 + B_{11}p11$$

$$= 1(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}094 + 0{,}048) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094) + (0{,}740 * 0{,}071) + (0{,}888 * 0{,}094) + (1{,}044 * 0{,}071) + (1{,}238 * 0{,}094) + (1{,}481 * 0{,}094)$$

$$= 1{,}669$$

b. Rata-Rata Jumlah Breakdown dalam n Periode Operasi

$$B = \frac{Bn}{n}$$

- $B = \frac{0{,}071}{1}$

$$= 0{,}071$$

- $B = \frac{0,172}{2}$
  $= 0,086$
- $B = \frac{0,260}{3}$
  $= 0,087$
- $B = \frac{0,397}{4}$
  $= 0,099$
- $B = \frac{0,492}{5}$
  $= 0,098$
- $B = \frac{0,611}{6}$
  $= 0,102$
- $B = \frac{0,740}{7}$
  $= 0,106$
- $B = \frac{0,888}{8}$
  $= 0,111$
- $B = \frac{1,044}{9}$
  $= 0,116$
- $B = \frac{1,238}{10}$
  $= 0,124$
- $B = \frac{2,980}{11}$
  $= 0,135$
- $B = \frac{3,359}{12}$
  $= 0,139$

c. Perkiraan Biaya Repair per n Periode Operasi

$TCr = B * Cr$

- $TCr_1 = 0{,}078 * Rp\ 50.036.000$
  $= Rp\ 3.574.000$
- $TCr_2 = 0{,}097 * Rp\ 50.036.000$
  $= Rp\ 4.297.310$
- $TCr_3 = 0{,}113 * Rp\ 50.036.000$
  $= Rp\ 4.329.051$
- $TCr_4 = 0{,}111 * Rp\ 50.036.000$
  $= Rp\ 4.967.869$
- $TCr_5 = 0{,}113 * Rp\ 50.036.000$
  $= Rp\ 4.923.959$
- $TCr_6 = 0{,}116 * Rp\ 50.036.000$
  $= Rp\ 5.092.916$
- $TCr_7 = 0{,}116 * Rp\ 50.036.000$
  $= Rp\ 5.291.676$
- $TCr_8 = 0{,}114 * Rp\ 50.036.000$
  $= Rp\ 5.556.613$
- $TCr_9 = 0{,}118 * Rp\ 50.036.000$
  $= Rp\ 5.806.724$
- $TCr_{10} = 0{,}124 * Rp\ 50.036.000$
  $= Rp6.195.008$
- $TCr_{11} = 0{,}129 * Rp\ 50.036.000$
  $= Rp6.735.493$
- $TCr_{12} = 0{,}135 * Rp\ 50.036.000$
  $= Rp\ 6.960.776$

d. **Biaya Preventive Maintanance per n Periode**

$$TCm_1 = \frac{N * Cm}{n}$$

- $TCm_1 = \frac{1 * Rp\ 33.580.000}{1}$

$= Rp\ 33.580.000$

- $TCm_{2} = \frac{1 * Rp\ 33.580.000}{2}$

  $= Rp\ 16.790.000$

- $TCm_{3} = \frac{1 * Rp\ 33.580.000}{3}$

  $= Rp\ 11.193.333$

- $TCm_{4} = \frac{1 * Rp\ 33.580.000}{4}$

  $= Rp\ 8.395.000$

- $TCm_{5} = \frac{1 * Rp\ 33.580.000}{5}$

  $= Rp\ 6.716.000$

- $TCm_{6} = \frac{1 * Rp\ 33.580.000}{6}$

  $= Rp\ 5.596.667$

- $TCm_{7} = \frac{1 * Rp\ 33.580.000}{7}$

  $= Rp\ 4.797.143$

- $TCm_{8} = \frac{1 * Rp\ 33.580.000}{8}$

  $= Rp 4.192.798.333$

- $TCm_{9} = \frac{1 * Rp\ 33.580.000}{9}$

  $= Rp\ 3.731.111$

- $TCm_{10} = \frac{1 * Rp\ 33.580.000}{10}$

  $= Rp\ 3.358.000$

- $TCm_{11} = \frac{1 * Rp\ 33.580.000}{11}$

  $= Rp\ 3.052.727$

- $TCm_{12} = \frac{1 * Rp\ 33.580.000}{12}$

$= Rp\ 2.798.333$

e. Total Biaya Maintenance per n Bulan Operasi

$TMC(n) = TCr(n) + TCm(n)$

- $TMC(1) = Rp\ 3.574.000 + Rp\ 33.580.000$
  $= Rp\ 37.154.000$
- $TMC(2) = Rp\ 4.297.310 + Rp\ 16.790.000$
  $= Rp\ 21.087.310$
- $TMC(3) = Rp\ 4.923.959 + Rp\ 11.193.333$
  $= Rp 15.522.385$
- $TMC(4) = Rp\ 4.967.869 + Rp\ 8.395.000$
  $= Rp\ 13.362.869$
- $TMC(5) = Rp\ 4.923.959 + Rp\ 6.716.000$
  $= Rp\ 11.639.959$
- $TMC(6) = Rp\ 5.092.916 + Rp\ 15.000$
  $= Rp\ 10.689.583$
- $TMC(7) = Rp\ 5.291.676 + Rp\ 4.797.143$
  $= Rp\ 10.088.819$
- $TMC(8) = Rp\ 5.556.613 + Rp\ 4.192.798.333$
  $= Rp\ 9.754.113$
- $TMC(9) = Rp\ 5.806.724 + Rp\ 10.000$
  $= Rp\ 9.537.835$
- $TMC(10) = Rp\ 6.195.008 + Rp\ 9.000$
  $= Rp\ 9.553.008$
- $TMC(11) = Rp\ 6.735.493 + Rp\ 3.052.727$
  $= Rp\ 9.788.220$
- $TMC(12) = Rp\ 932.672 + Rp\ 2.798.333$
  $= Rp\ 9.759.110$

Oil cooler

a. Kumulatif Jumlah *Breakdown* dalam n Periode Operasi oil cooler (pengerjaan crew kapal)

$B_1 = N * p1$

$= 1 * 0{,}071$

$= 0{,}071$

$B_2 = N(p1 + p2) + B_1 p1$

$= 1(0{,}071 + 0{,}094) + (0{,}071 * 0{,}071)$

$= 0{,}172$

$B_3 = N(p1 + p2 + p3) + B_1 p1 + B_2 p2$

$= 1(0{,}071 + 0{,}094 + 0{,}071) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094)$

$= 0{,}260$

$B_4 = 1(p1 + p2 + p3 + p4) + B_1 p1 + B_2 p2 + B_3 p3$

$= 1(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119) + (0{,}071 * 0{,}071) +$

$(0{,}172 * 0{,}094) + (0{,}260 * 0{,}071)$

$= 0{,}397$

$B_5 = 1(p1 + p2 + p3 + p4 + p5) + B_1 p1 + B_2 p2 + B_3 p3 + B_4 p4$

$= 2(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119) + (0{,}071 * 0{,}071)$

$+ (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119)$

$= 0{,}492$

$B_6 = 1(p1 + p2 + p3 + p4 + p5 + p6) + B_1 p1 + B_2 p2 + B_3 p3 + B_4 p4$

$+ B_5 p5$

$= 1(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048) + (0{,}071 * 0{,}071)$

$+ (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119)$

$+ (0{,}492 * 0{,}048)$

$= 0{,}611$

$B_7 = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7) + B_1 p1 + B_2 p2 + B_3 p3$

$+ B_4 p4 + B_5 p5 + B_6 p6$

$$= 2(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094)$$

$$= 0{,}740$$

$$B_8 = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7$$

$$= 2(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094) + (0{,}740 * 0{,}071)$$

$$= 0{,}888$$

$$B_9 = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8$$

$$= 1\,(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071 + 0{,}094) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094) + (0{,}740 * 0{,}071) + (0{,}888 * 0{,}094)$$

$$= 1{,}044$$

$$B_{10} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9$$

$$= 1(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071 + 0{,}094 + 0{,}071 + 0{,}119) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094) + (0{,}740 * 0{,}071) + (0{,}888 * 0{,}094) + (1{,}044 * 0{,}071)$$

$$= 1{,}238$$

$$B_{11} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9 + B_{10}p10$$

$$= 1(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}094) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094) + (0{,}740 * 0{,}071) + (0{,}888 * 0{,}094) + (1{,}044 * 0{,}071) + (1{,}238 * 0{,}094)$$

$$= 1{,}481$$

$$B_{12} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11 + p12) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9 + B_{10}p10 + B_{11}p11$$

$$= 1(0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}048 + 0{,}094 + 0{,}071 + 0{,}094 + 0{,}071 + 0{,}119 + 0{,}094 + 0{,}048) + (0{,}071 * 0{,}071) + (0{,}172 * 0{,}094) + (0{,}260 * 0{,}071) + (0{,}397 + 0{,}119) + (0{,}492 * 0{,}048) + (0{,}611 * 0{,}094) + (0{,}740 * 0{,}071) + (0{,}888 * 0{,}094) + (1{,}044 * 0{,}071) + (1{,}238 * 0{,}094) + (1{,}481 * 0{,}094)$$

$$= 1{,}669$$

c. Rata-Rata Jumlah Breakdown dalam n Periode Operasi

$$B = \frac{Bn}{n}$$

- $B = \frac{0{,}071}{1}$
  $= 0{,}071$
- $B = \frac{0{,}172}{2}$
  $= 0{,}086$
- $B = \frac{0{,}260}{3}$
  $= 0{,}087$
- $B = \frac{0{,}397}{4}$
  $= 0{,}099$
- $B = \frac{0{,}492}{5}$

$= 0{,}098$

- $B = \frac{0{,}611}{6}$
  $= 0{,}102$
- $B = \frac{0{,}740}{7}$
  $= 0{,}106$
- $B = \frac{0{,}888}{8}$
  $= 0{,}111$
- $B = \frac{1{,}044}{9}$
  $= 0{,}116$
- $B = \frac{1{,}238}{10}$
  $= 0{,}124$
- $B = \frac{2{,}980}{11}$
  $= 0{,}135$
- $B = \frac{3{,}359}{12}$
  $= 0{,}139$

f. Perkiraan Biaya Repair per n Periode Operasi

$TCr = B * Cr$

- $TCr_1 = 0{,}078 * Rp\ 50.596.032$
  $= Rp\ 3.614.002$
- $TCr_2 = 0{,}097 * Rp\ 50.596.032$
  $= Rp\ 4.345.408$
- $TCr_3 = 0{,}113 * Rp\ 50.596.032$
  $= Rp\ 4.377.505$
- $TCr_4 = 0{,}111 * Rp\ 50.596.032$
  $= Rp\ 5.023.472$

- $TCr_5 = 0{,}113 * Rp\ 50.596.032$
  $= Rp\ 4.979.070$
- $TCr_6 = 0{,}116 * Rp\ 50.596.032$
  $= Rp\ 5.149.919$
- $TCr_7 = 0{,}116 * Rp\ 50.596.032$
  $= Rp\ 5.350.904$
- $TCr_8 = 0{,}114 * Rp\ 50.596.032$
  $= Rp\ 5.618.806$
- $TCr_9 = 0{,}118 * Rp\ 50.596.032$
  $= Rp\ 5.871.716$
- $TCr_{10} = 0{,}124 * Rp\ 50.596.032$
  $= Rp 6.264.346$
- $TCr_{11} = 0{,}135 * Rp\ 50.596.032$
  $= Rp 6.810.880$
- $TCr_{12} = 0{,}139 * Rp\ 50.596.032$
  $= Rp\ 7.038.686$

g. **Biaya Preventive Maintanance per n Periode**

$$TCm_1 = \frac{N * Cm}{n}$$

- $TCm_1 = \frac{1 * Rp\ 34.140.032}{1}$
  $= Rp\ 34.140.032$
- $TCm_2 = \frac{1 * Rp\ 34.140.032}{2}$
  $= Rp\ 17.070.016$
- $TCm_3 = \frac{1 * Rp\ 34.140.032}{3}$
  $= Rp\ 11.380.011$
- $TCm_4 = \frac{1 * Rp\ 34.140.032}{4}$
  $= Rp\ 8.535.008$

- $TCm_{5} = \frac{1*Rp\ 34.140.032}{5}$

  $= Rp\ 6.828.006$

- $TCm_{6} = \frac{1*Rp\ 34.140.032}{6}$

  $= Rp\ 5.690.005$

- $TCm_{7} = \frac{1*Rp\ 34.140.032}{7}$

  $= Rp\ 4.877.147$

- $TCm_{8} = \frac{1*Rp\ 34.140.032}{8}$

  $= Rp4.267.504$

- $TCm_{9} = \frac{1*Rp\ 34.140.032}{9}$

  $= Rp\ 3.793.337$

- $TCm_{10} = \frac{1*Rp\ 34.140.032}{10}$

  $= Rp\ 3.414.003$

- $TCm_{11} = \frac{1*Rp\ 34.140.032}{11}$

  $= Rp\ 3.103.639$

- $TCm_{12} = \frac{1*Rp\ 34.140.032}{12}$

  $= Rp\ 2.845.003$

h. Total Biaya Maintenance per n Bulan Operasi

$TMC(n) = TCr(n) + TCm(n)$

- $TMC(1) = Rp\ 3.614.002 + Rp\ 34.140.032$

  $= Rp\ 37.754.034$

- $TMC(2) = Rp\ 4.345.408 + Rp\ 17.070.016$

  $= Rp\ 21.415.424$

- $TMC(3) = Rp\ 4.979.070 + Rp\ 11.380.011$

$= Rp15.757.515$

- $TMC(4) = Rp\ 5.023.472 + Rp\ 8.535.008$
  $= Rp\ 13.558.480$
- $TMC(5) = Rp\ 4.979.070 + Rp\ 6.828.006$
  $= Rp\ 11.807.077$
- $TMC(6) = Rp\ 5.149.919 + Rp\ 5.690.005$
  $= Rp\ 10.839.924$
- $TMC(7) = Rp\ 5.350.904 + Rp\ 4.877.147$
  $= Rp\ 10.228.051$
- $TMC(8) = Rp\ 5.618.806 + Rp\ 4.267.504$
  $= Rp\ 9.886.310$
- $TMC(9) = Rp\ 5.871.716 + Rp\ 3.793.337$
  $= Rp\ 9.665.053$
- $TMC(10) = Rp\ 6.264.346 + Rp\ 3.414.003$
  $= Rp\ 9.678.349$
- $TMC(11) = Rp\ 6.810.880 + Rp\ 3.103.639$
  $= Rp\ 9.914.520$
- $TMC(12) = Rp\ 932.672 + Rp\ 2.845.003$
  $= Rp\ 9.883.688$

Oil filter

a. Kumulatif Jumlah *Breakdown* dalam n Periode Operasi oil filter (pengerjaan mekanik)

$B_1 = N * p1$
$= 1 * 0{,}078$
$= 0{,}078$

$B_2 = N(p1 + p2) + B_1 p1$
$= 1(0{,}078 + 0{,}219) + (0{,}078 * 0{,}078)$
$= 0{,}194$

$B_3 = N(p1 + p2 + p3) + B_1 p1 + B_2 p2$
$= 1(0{,}078 + 0{,}219 + 0{,}125) + (0{,}078 * 0{,}078) + (0{,}194 * 0{,}219)$

$$= 0{,}340$$

$$B_4 = 1(p1 + p2 + p3 + p4) + B_1p1 + B_2p2 + B_3p3$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063) + (0{,}078 * 0{,}078) +$$

$$(0{,}0{,}097 * 0{,}219) + \quad (0{,}340 * 0{,}125)$$

$$= 0{,}445$$

$$B_5 = 1(p1 + p2 + p3 + p4 + p5) + B_1p1 + B_2p2 + B_3p3 + B_4p4$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094) + (0{,}078 * 0{,}078) +$$

$$(0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) + (0{,}445 + 0{,}063)$$

$$= 0{,}556$$

$$B_6 = 1(p1 + p2 + p3 + p4 + p5 + p6) + B_1p1 + B_2p2 + B_3p3 +$$

$$B_4p4 + B_5p5$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078) +$$

$$(0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) +$$

$$(0{,}397 + 0{,}063) + (0{,}556 * 0{,}094)$$

$$= 0{,}698$$

$$B_7 = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7) + B_1p1 + B_2p2 + B_3p3 +$$

$$B_4p4 + B_5p5 + B_6p6$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063) +$$

$$(0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) +$$

$$(0{,}397 + 0{,}063) + (0{,}556 * 0{,}048) + (0{,}698 * 0{,}078)$$

$$= 0{,}815$$

$$B_8 = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8) + B_1p1 + B_2p2 +$$

$$B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063 +$$

$$0{,}047) +$$

$$= 0{,}912$$

$$B_9 = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9) + B_1p1 +$$

$$B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063 +$$

$$0{,}047 + 0{,}109) + (0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) +$$

$$(0{,}113 * 0{,}125) + (0{,}397 + 0{,}063) + (0{,}556 * 0{,}048) + (0{,}698 * 0{,}078) + (0{,}815 * 0{,}063) + (0{,}912 * 0{,}047)$$

$$= 1{,}064$$

$$B_{10} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063 + 0{,}047 + 0{,}109 + 0{,}063) + (0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) + (0{,}397 + 0{,}063) + (0{,}556 * 0{,}048) + (0{,}698 * 0{,}078) + (0{,}815 * 0{,}063) + (0{,}912 * 0{,}047) + (1{,}064 * 0{,}109)$$

$$= 1{,}243$$

$$B_{11} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9 + B_{10}p10$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063 + 0{,}047 + 0{,}109 + 0{,}063 + 0{,}094) + (0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) + (0{,}397 + 0{,}063) + (0{,}556 * 0{,}048) + (0{,}698 * 0{,}078) + (0{,}815 * 0{,}063) + (0{,}912 * 0{,}047) + (1{,}064 * 0{,}109) + (1{,}243 * 0{,}063)$$

$$= 1{,}415$$

$$B_{12} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11 + p12) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9 + B_{10}p10 + B_{11}p11$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063 + 0{,}047 + 0{,}109 + 0{,}063 + 0{,}094 + 0{,}078) + (0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) + (0{,}397 + 0{,}063) + (0{,}556 * 0{,}048) + (0{,}698 * 0{,}078) + (0{,}815 * 0{,}063) + (0{,}912 * 0{,}047) + (1{,}064 * 0{,}109) + (1{,}243 * 0{,}063) + (1{,}415 * 0{,}094)$$

$= 1{,}626$

d. Rata-Rata Jumlah Breakdown dalam n Periode Operasi

$$B = \frac{Bn}{n}$$

- $B = \frac{0{,}078}{1}$
  $= 0{,}078$
- $B = \frac{0{,}194}{2}$
  $= 0{,}097$
- $B = \frac{0{,}340}{3}$
  $= 0{,}113$
- $B = \frac{0{,}445}{4}$
  $= 0{,}111$
- $B = \frac{0{,}566}{5}$
  $= 0{,}113$
- $B = \frac{0{,}698}{6}$
  $= 0{,}116$
- $B = \frac{0{,}815}{7}$
  $= 0{,}116$
- $B = \frac{0{,}912}{8}$
  $= 0{,}114$
- $B = \frac{1{,}064}{9}$
  $= 0{,}118$
- $B = \frac{1{,}243}{10}$
  $= 0{,}124$

- $B = \frac{1,415}{11}$

  $= 0,129$

- $B = \frac{1,626}{12}$

  $= 0,135$

i. Perkiraan Biaya Repair per n Periode Operasi

$TCr = B * Cr$

- $TCr_1 = 0,078 * Rp\ 40.310.000$

  $=$ Rp3.149,219
- $TCr_2 = 0,097 * Rp\ 40.310.000$

  $=$ Rp3.902.079
- $TCr_3 = 0,113 * Rp\ 40.310.000$

  $=$ Rp4.565.496
- $TCr_4 = 0,111 * Rp\ 40.310.000$

  $=$ Rp4.481.981
- $TCr_5 = 0,113 * Rp\ 40.310.000$

  $=$ Rp4.565.496
- $TCr_6 = 0,116 * Rp\ 40.310.000$

  $=$ Rp4.686.129
- $TCr_7 = 0,116 * Rp\ 40.310.000$

  $=$ Rp4.690.396
- $TCr_8 = 0,114 * Rp\ 40.310.000$

  $=$ Rp4.596.794
- $TCr_9 = 0,118 * Rp\ 40.310.000$

  $=$ Rp4.767.451
- $TCr_{10} = 0,124 * Rp\ 40.310.000$

  $=$ Rp5.011.939
- $TCr_{11} = 0,129 * Rp\ 40.310.000$

  Rp5.184.629
- $TCr_{12} = 0,135 * Rp\ 40.310.000$

$= \text{Rp}5.460.565$

j. **Biaya Preventive Maintanance per n Periode**

$$TCm_{\,1} = \frac{N * Cm}{n}$$

- $TCm_{\,1} = \frac{1 * Rp\ 33.515.000}{1}$

  $= Rp\ 33.515.000$

- $TCm_{\,2} = \frac{1 * Rp\ 33.515.000}{2}$

  $= \text{Rp } 16.757.500$

- $TCm_{\,3} = \frac{1 * Rp\ 33.515.000}{3}$

  $= \text{Rp } 11.171.667$

- $TCm_{\,4} = \frac{1 * Rp\ 33.515.000}{4}$

  $= \text{Rp } 8.378.750$

- $TCm_{\,5} = \frac{1 * Rp\ 33.515.000}{5}$

  $=\text{Rp } 6.703.000$

- $TCm_{\,6} = \frac{1 * Rp\ 33.515.000}{6}$

  $= \text{Rp } 5.585.833$

- $TCm_{\,7} = \frac{1 * Rp\ 33.515.000}{7}$

  $= \text{Rp } 4.787.857$

- $TCm_{\,8} = \frac{1 * Rp\ 33.515.000}{8}$

  $= \text{Rp } 4.189.375$

- $TCm_{\,9} = \frac{1 * Rp\ 33.515.000}{9}$

  $= \text{Rp } 3.723.889$

- $TCm_{10} = \frac{1 * Rp\ 33.515.000}{10}$

  $= \text{Rp } 3.351.500$

- $TCm_{11} = \frac{1 * Rp\ 33.515.000}{11}$

  $= \text{Rp } 3.046.818$

- $TCm_{12} = \frac{1 * Rp\ 33.515.000}{12}$

  $= \text{Rp } 2.792.917$

k. Total Biaya Maintenance per n Bulan Operasi

$TMC(n) = TCr(n) + TCm(n)$

- $TMC(1) = Rp\ 3.149.219 + Rp\ 33.515.000$
  $= Rp\ 36.664.219$
- $TMC(2) = Rp\ 3.902.079 + \text{Rp } 16.757.500$
  $= RRp\ 20.659.579$
- $TMC(3) = Rp\ 4.565.496 + \text{Rp } 11.171.667$
  $= Rp\ 15.737.162$
- $TMC(4) = Rp\ 4.481.981 + \text{Rp } 8.378.750$
  $= Rp\ 12.860.731$
- $TMC(5) = Rp\ 4.565.496 + \text{Rp } 6.703.000$
  $= Rp\ 11.268.496$
- $TMC(6) = Rp\ 4.686.129 + \text{Rp } 5.585.833$
  $= Rp\ 10.271.963$
- $TMC(7) = Rp\ 4.690.396 + \text{Rp } 4.787.857$
  $= Rp\ 9.478.253$
- $TMC(8) = Rp\ 4.596.794 + \text{Rp } 4.189.375$
  $= Rp\ 8.786.169$
- $TMC(9) = Rp\ 4.767.451 + \text{Rp } 3.723.889$
  $= Rp\ 8.491.340$
- $TMC(10) = Rp\ 5.011.939 + \text{Rp } 3.351.500$

$= Rp\ 8.363.439$

- $TMC(11) = Rp\ 5.184.629 + \text{Rp}\ 3.046.818$

  $= Rp\ 8.231.447$

- $TMC(12) = Rp\ 5.460.565 + \text{Rp}\ 2.792.917$

  $= Rp\ 8.253.482$

Oil filter

a. Kumulatif Jumlah *Breakdown* dalam n Periode Operasi oil filter (pengerjaan crew kapal)

$B_1 = N * p1$

$= 1 * 0{,}078$

$= 0{,}078$

$B_2 = N(p1 + p2) + B_1 p1$

$= 1(0{,}078 + 0{,}219) + (0{,}078 * 0{,}078)$

$= 0{,}194$

$B_3 = N(p1 + p2 + p3) + B_1 p1 + B_2 p2$

$= 1(0{,}078 + 0{,}219 + 0{,}125) + (0{,}078 * 0{,}078) + (0{,}194 * 0{,}219)$

$= 0{,}340$

$B_4 = 1(p1 + p2 + p3 + p4) + B_1 p1 + B_2 p2 + B_3 p3$

$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063) + (0{,}078 * 0{,}078) +$

$(0{,}0{,}097 * 0{,}219) + \quad (0{,}340 * 0{,}125)$

$= 0{,}445$

$B_5 = 1(p1 + p2 + p3 + p4 + p5) + B_1 p1 + B_2 p2 + B_3 p3 + B_4 p4$

$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094) + (0{,}078 * 0{,}078) +$

$(0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) + (0{,}445 + 0{,}063)$

$= 0{,}556$

$B_6 = 1(p1 + p2 + p3 + p4 + p5 + p6) + B_1 p1 + B_2 p2 + B_3 p3 +$

$B_4 p4 + B_5 p5$

$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078) +$

$(0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) +$

$(0{,}397 + 0{,}063) + (0{,}556 * 0{,}094)$

$$= 0{,}698$$

$$B_7 = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063) + (0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) + (0{,}397 + 0{,}063) + (0{,}556 * 0{,}048) + (0{,}698 * 0{,}078)$$

$$= 0{,}815$$

$$B_8 = 1(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063 + 0{,}047) +$$

$$= 0{,}912$$

$$B_9 = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063 + 0{,}047 + 0{,}109) + (0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) + (0{,}397 + 0{,}063) + (0{,}556 * 0{,}048) + (0{,}698 * 0{,}078) + (0{,}815 * 0{,}063) + (0{,}912 * 0{,}047)$$

$$= 1{,}064$$

$$B_{10} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063 + 0{,}047 + 0{,}109 + 0{,}063) + (0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) + (0{,}397 + 0{,}063) + (0{,}556 * 0{,}048) + (0{,}698 * 0{,}078) + (0{,}815 * 0{,}063) + (0{,}912 * 0{,}047) + (1{,}064 * 0{,}109)$$

$$= 1{,}243$$

$$B_{11} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9 + B_{10}p10$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063 + 0{,}047 + 0{,}109 + 0{,}063 + 0{,}094) + (0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) + (0{,}397 + 0{,}063) + (0{,}556 * 0{,}048) + (0{,}698 * 0{,}078) + (0{,}815 * 0{,}063) + (0{,}912 * 0{,}047) + (1{,}064 * 0{,}109) + (1{,}243 * 0{,}063)$$

$$= 1{,}415$$

$$B_{12} = N(p1 + p2 + p3 + p4 + p5 + p6 + p7 + p8 + p9 + p10 + p11 + p12) + B_1p1 + B_2p2 + B_3p3 + B_4p4 + B_5p5 + B_6p6 + B_7p7 + B_8p8 + B_9p9 + B_{10}p10 + B_{11}p11$$

$$= 1(0{,}078 + 0{,}219 + 0{,}125 + 0{,}063 + 0{,}094 + 0{,}078 + 0{,}063 + 0{,}047 + 0{,}109 + 0{,}063 + 0{,}094 + 0{,}078) + (0{,}078 * 0{,}078) + (0{,}0{,}097 * 0{,}219) + (0{,}113 * 0{,}125) + (0{,}397 + 0{,}063) + (0{,}556 * 0{,}048) + (0{,}698 * 0{,}078) + (0{,}815 * 0{,}063) + (0{,}912 * 0{,}047) + (1{,}064 * 0{,}109) + (1{,}243 * 0{,}063) + (1{,}415 * 0{,}094)$$

$$= 1{,}626$$

e. Rata-Rata Jumlah Breakdown dalam n Periode Operasi

$$B = \frac{Bn}{n}$$

- $B = \frac{0{,}078}{1}$
  $= 0{,}078$
- $B = \frac{0{,}194}{2}$
  $= 0{,}097$
- $B = \frac{0{,}340}{3}$
  $= 0{,}113$

- $B = \frac{0,445}{4}$
  $= 0,111$
- $B = \frac{0,566}{5}$
  $= 0,113$
- $B = \frac{0,698}{6}$
  $= 0,116$
- $B = \frac{0,815}{7}$
  $= 0,116$
- $B = \frac{0,912}{8}$
  $= 0,114$
- $B = \frac{1,064}{9}$
  $= 0,118$
- $B = \frac{1,243}{10}$
  $= 0,124$
- $B = \frac{1,415}{11}$
  $= 0,129$
- $B = \frac{1,626}{12}$
  $= 0,135$

l. Perkiraan Biaya Repair per n Periode Operasi

$TCr = B * Cr$

- $TCr_1 = 0,078 * Rp\ 11.067.504$
  $= Rp\ 864.649$
- $TCr_2 = 0,097 * Rp\ 11.067.504$
  $= Rp\ 1.071.354$

- $TCr_{3} = 0{,}113 * Rp\ 11.067.504$
  $= Rp\ 1.253.501$
- $TCr_{4} = 0{,}111 * Rp\ 11.067.504$
  $= Rp\ 1.230.572$
- $TCr_{5} = 0{,}113 * Rp\ 11.067.504$
  $= Rp\ 1.253.502$
- $TCr_{6} = 0{,}116 * Rp\ 11.067.504$
  $= Rp\ 1.286.623$
- $TCr_{7} = 0{,}116 * Rp\ 11.067.504$
  $= Rp\ 1.287.794$
- $TCr_{8} = 0{,}114 * Rp\ 11.067.504$
  $= Rp\ 1.262.095$
- $TCr_{9} = 0{,}118 * Rp\ 11.067.504$
  $= Rp\ 1.308.950$
- $TCr_{10} = 0{,}124 * Rp\ 11.067.504$
  $= Rp\ 1.376.077$
- $TCr_{11} = 0{,}129 * Rp\ 11.067.504$
  $= Rp\ 1.42.490$
- $TCr_{12} = 0{,}135 * Rp\ 11.067.504$
  $= Rp\ 1.499.252$

m. **Biaya Preventive Maintanance per n Periode**

$$TCm_{1} = \frac{N * Cm}{n}$$

- $TCm_{1} = \frac{1 * Rp\ 4.272.694}{1}$
  $= Rp\ 4.272.694$
- $TCm_{2} = \frac{1 * Rp\ 4.272.694}{2}$
  $= Rp\ 2.136.252$
- $TCm_{3} = \frac{1 * Rp\ 4.272.694}{3}$

$= Rp\ 1.424.168$

- $TCm_{4} = \frac{1 * Rp\ 4.272.694}{4}$

  $= Rp\ 1.068.126$

- $TCm_{5} = \frac{1 * Rp\ 4.272.694}{5}$

  $= Rp\ 854.501$

- $TCm_{6} = \frac{1 * Rp\ 4.272.694}{6}$

  $= Rp\ 712.084$

- $TCm_{7} = \frac{1 * Rp\ 4.272.694}{7}$

  $= Rp\ 610.358$

- $TCm_{8} = \frac{1 * Rp\ 4.272.694}{8}$

  $= Rp\ 534.063$

- $TCm_{9} = \frac{1 * Rp\ 4.272.694}{9}$

  $= Rp\ 474.723$

- $TCm_{10} = \frac{1 * Rp\ 4.272.694}{10}$

  $= Rp\ 427.250$

- $TCm_{11} = \frac{1 * Rp\ 4.272.694}{11}$

  $= Rp\ 388.409$

- $TCm_{12} = \frac{1 * Rp\ 4.272.694}{12}$

  $= Rp\ 356.042$

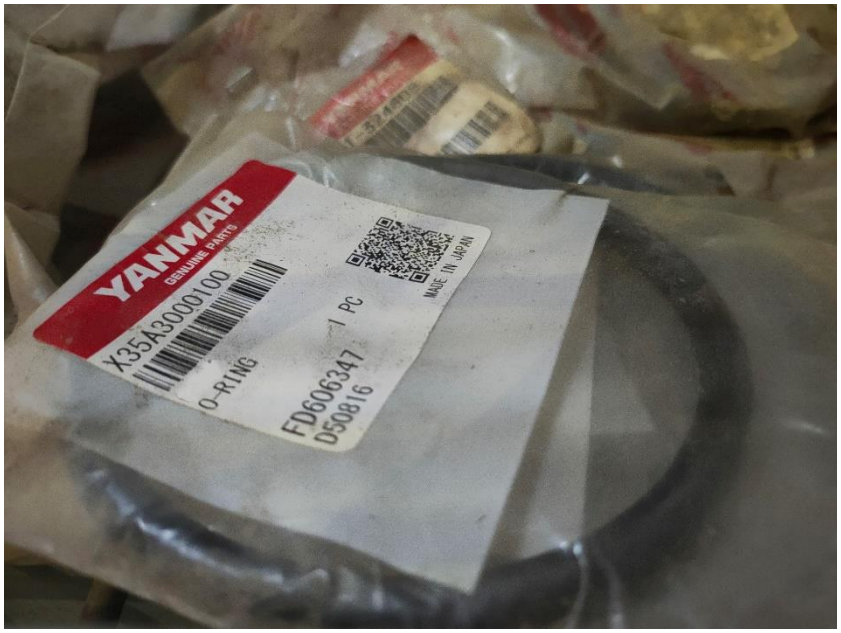
n. Total Biaya Maintenance per n Bulan Operasi

$TMC(n) = TCr(n) + TCm(n)$

- $TMC(1) = Rp\ 864.649 + Rp\ 4.272.694$
  $= Rp\ 5.137.153$
- $TMC(2) = Rp\ 1.071.354 + Rp\ 2.136.252$
  $= Rp\ 3.207.606$
- $TMC(3) = Rp\ 1.253.501 + Rp\ 1.424.168$
  $= Rp\ 2.677.669$
- $TMC(4) = Rp\ 1.230.5728 + Rp\ 1.068.126$
  $= Rp\ 2.298.698$
- $TMC(5) = Rp1.253.502 + Rp\ 854.501$
  $= Rp\ 2.108.002$
- $TMC(6) = Rp\ 1.286.623 + Rp\ 712.084$
  $= Rp\ 1.998.007$
- $TMC(7) = Rp1.287.794 + Rp\ 610.358$
  $= Rp\ 1.898.152$
- $TMC(8) = Rp\ 1.262.095 + Rp\ 534.063$
  $= Rp\ 1.796.158$
- $TMC(9) = Rp\ 1.308.950 + Rp\ 474.723$
  $= Rp\ 1.783.673$
- $TMC(10) = Rp\ 1.376.077 + Rp\ 427.250$
  $= Rp\ 1.803.327$
- $TMC(11) = Rp\ 1.42.490 + Rp\ 388.409$
  $= Rp\ 1.811.900$
- $TMC(12) = Rp\ 1.499.252 + Rp\ 7.500$
  $= Rp\ 1.855.294$

DAFTAR HARGA SPAREPART

NAMA BARANG	GAMBAR BARANG	HARGA SATUAN
O- RING SEAL G 165		Rp. 75.000,00
O- RING SEAL G 155		Rp. 75.000,00

O- RING SEAL G 60		Rp. 25.000,00
O- RING SEAL G 55		Rp. 25.000,00

O- RING SEAL G 25		Rp.25.000,00
OIL FILTER		Rp. 235.000,00

ZINK-ANTI CORROSIVE		Rp. 189.000

Demikian harga sparepart yang ada digalangan kami, harga tidak termasuk biaya pergantian sparepart.

Samarinda, 02 Februari 2021

Mengetahui,

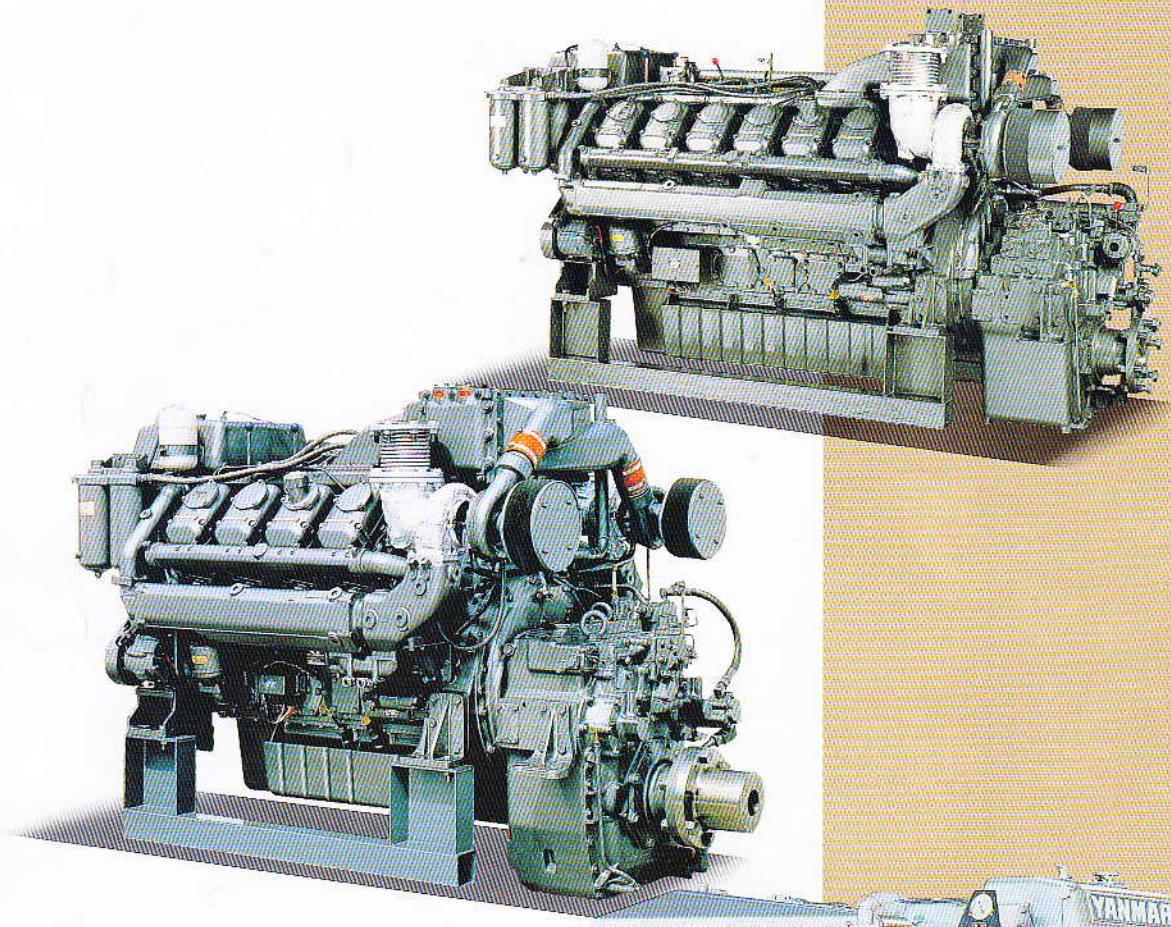
MKS SHIPYARD
PRODUCTION

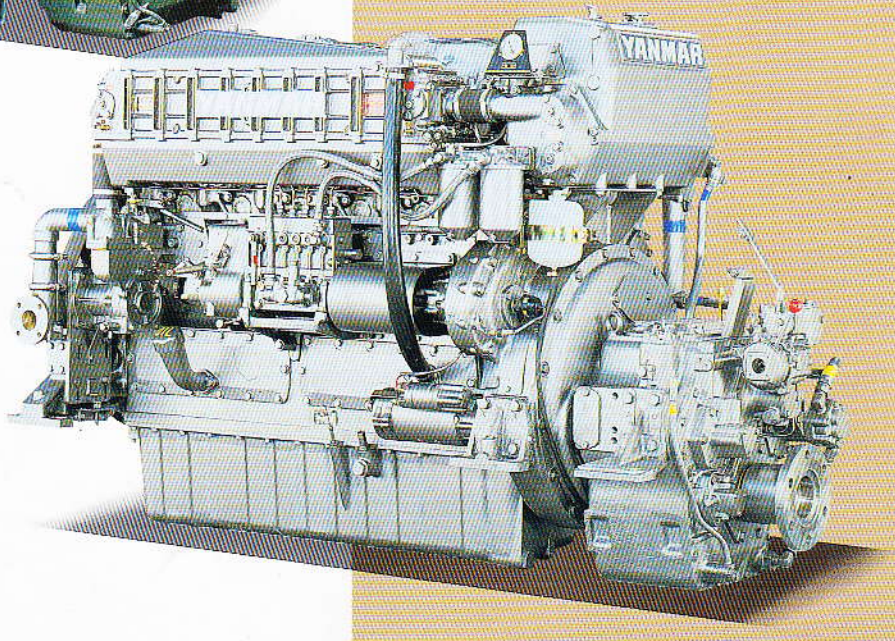
Ayub Paturahman

MARINE DIESEL ENGINES

LAA(M)-UTE series
530~1130hp(395.4~843.0kW)

YANMAR





Photograph may show optional equipment.

A Great Engine Gets Better

The high status enjoyed in the workboat world by the LA series of diesel engines takes a big leap upwards with the introduction of the UTE version.
This latest range benefits greatly from the modern innovations brought into diesel technology. At the same time it puts years of diesel experience to work for your boat.
The top line model punches more horsepower out of a body as much as 22% more compact than its nearest rival. Its low weight gives you far more payload potential.
What makes the UTE so special?

- First there's a remarkably efficient new fuel pump whose ultra-high pressure and super-accurate timing help achieve almost 100% combustibility.
- There are four precision-timed valves per head to boost air-gas flow.
- To make sure you get all this increased performance without any increase in problems, the very latest high temperature materials are used in all vital parts.
- Improved turbocharging, backed up by an intercooler, help take power to an efficient maximum.
- Using the UTE is also a new experience in diesel operation as it runs smoother from a constant coolant temperature level and checks out easier from such features as inspection windows in the blocks.

ENGINE SPECIFICATIONS

Model (with marine gear)		6LAA-UTE	8LAA-UTE	12LAA-UTE1
Model (without marine gear)		6LAAM-UTE	8LAAM-UTE	12LAAM-UTE1
Type		4-cycle, vertical, turbo-charged, water cooled diesel engine		
Number of cylinders		6 in-line	8-vee	12-vee
Bore × stroke	mm (in)	148 × 165 (5.83 × 6.50)		
Displacement	ℓ (cu.in)	17.03 (1039.2)	22.7 (1385.2)	34.1 (2080.9)
Continuous rating output hp/rpm	with marine gear	530/1850	650/1850	1000/1850
	without marine gear	550/1850	670/1850	1035/1850
Maxmum output hp/rpm	with marine gear	580/1900 / 605/1950	715/1900	1100/1900
	without marine gear	600/1900 / 625/1950	737/1900	1130/1900
Fuel consumption (without marine gear)	gr/hp.h	158	160	159
Direction of rotation (crankshaft)		Counterclockwise viewed from stern		
Combustion system		Direct injection		
Cooling system		Fresh water cooling with seawater & fresh water pumps		
Lubricating system		Forced lubrication with gear pump		
Starting system		Electric starting motor (DC 24V)		
Dry weight (without marine gear)	kg (lbs)	1890 (4167)	2420 (5336)	3300 (7276)

MARINE GEAR SPECIFICATIONS

Engine model: 6LAA-UTE

Model	YX180				YX180L	
Type	Hydraulic multi-disc clutch, wet type					
Reduction ratio (forward)	2.08	2.55	3.03	3.50	4.00	4.54
Propeller shaft speed (at cont. rating) rpm	889	725	611	529	463	407
Direction of rotation (propeller shaft)	Clockwise or counterclockwise viewed from stern					
Dry weight kg (lbs)	500 (1102)					

Engine model: 8LAA-UTE

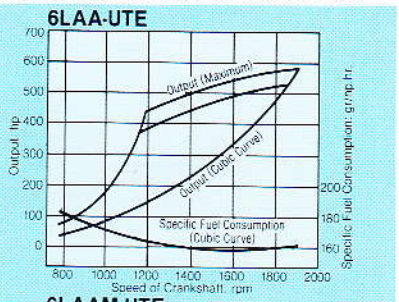
Model	YX350E				YX350L		MGN86E				MGN86EL		MGN87L	
Type	Hydraulic multi-disc clutch, wet type													
Reduction ratio (forward)	2.25	2.67	3.11	3.51	4.08	4.52	2.06	2.44	2.93	3.40	3.93	4.48	4.90	5.54
Propeller shaft speed (at cont. rating) rpm	822	693	595	527	453	409	899	758	634	544	471	413	378	334
Direction of rotation (propeller shaft)	Clockwise or counterclockwise viewed from stern													
Dry weight kg (lbs)	900 (1985)				1350 (2970)		720 (1588)				900 (1985)		1450 (3197)	

Engine model: 12LAA-UTE1

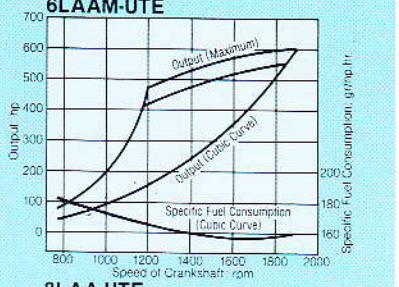
Model	MGN332				YX350E				YX350L		MGN624		
Type	Hydraulic multi-disc clutch, wet type												
Reduction ratio (forward)	1.00	1.45	2.04	2.38	2.25	2.67	3.11	3.51	4.08	4.52	4.00	4.56	5.00
Propeller shaft speed (at cont. rating) rpm	1850	1276	907	777	822	693	595	527	453	409	463	406	370
Direction of rotation (propeller shaft)	Clockwise or counterclockwise viewed from stern												
Dry weight kg (lbs)	566 (1234)				900 (1985)				1350 (2970)		1550 (2991)		

PERFORMANCE CURVES

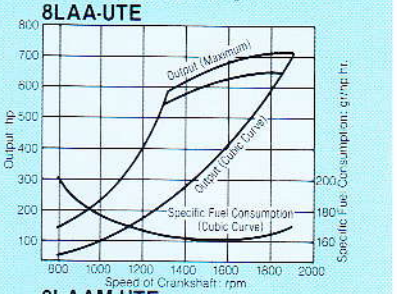
6LAA-UTE



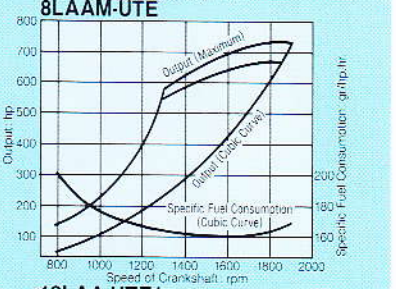
6LAAM-UTE



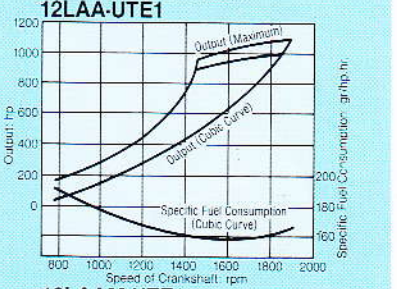
8LAA-UTE



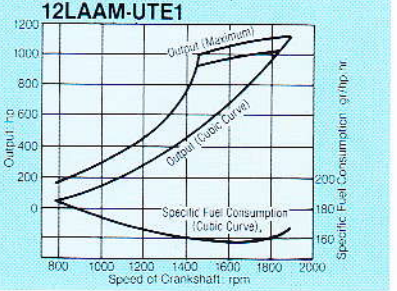
8LAAM-UTE



12LAA-UTE1

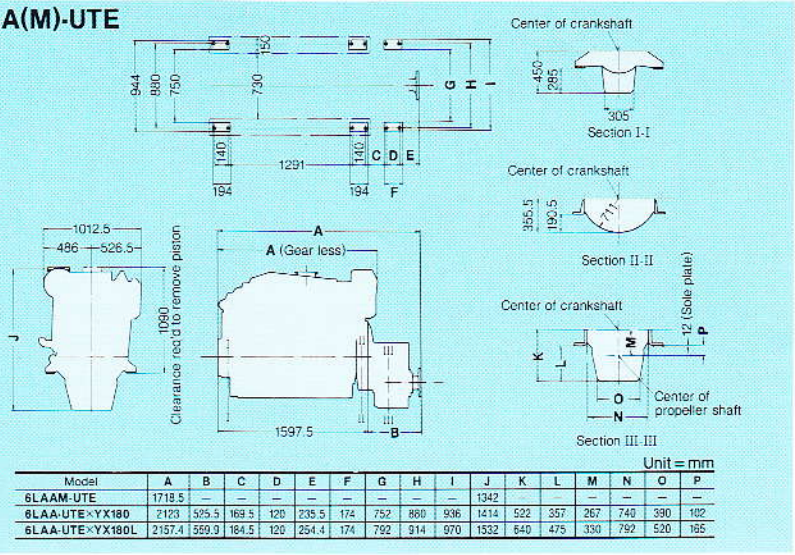


12LAAM-UTE1



DIMENSIONS

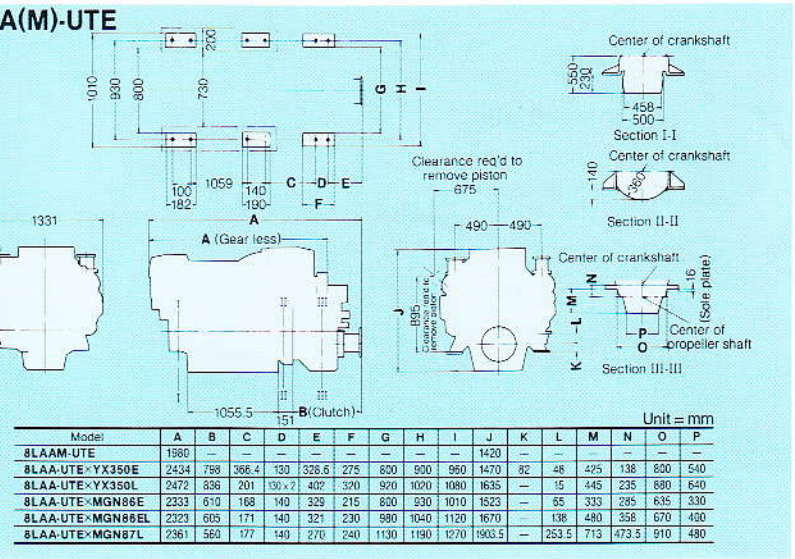
6LAA(M)-UTE



Unit = mm

Model	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
6LAAM-UTE	1718.5	–	–	–	–	–	–	–	–	1342	–	–	–	–	–	–
6LAA-UTE×YX180	2123	525.5	169.5	120	235.5	174	752	880	936	1414	522	357	267	740	390	102
6LAA-UTE×YX180L	2157.4	559.9	184.5	120	254.4	174	792	914	970	1532	640	475	330	792	520	165

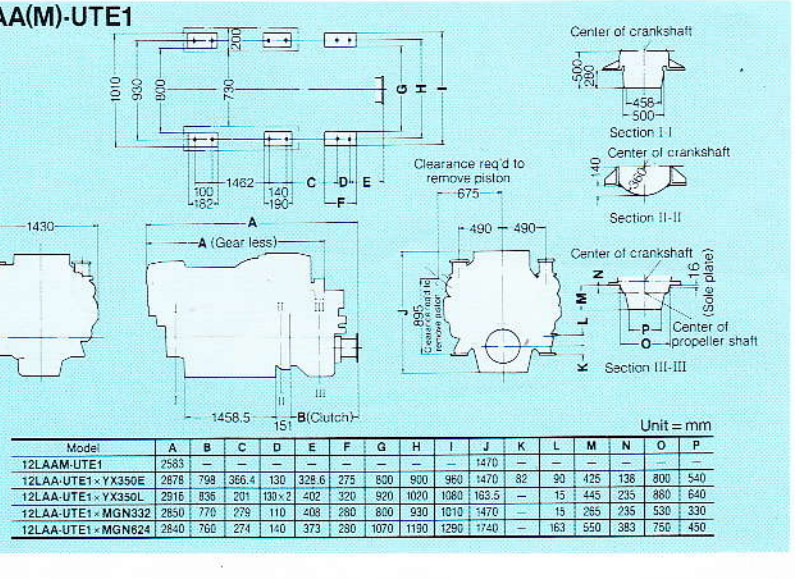
8LAA(M)-UTE



Unit = mm

Model	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
8LAAM-UTE	1980	–	–	–	–	–	–	–	–	1420	–	–	–	–	–	–
8LAA-UTE×YX350E	2434	798	366.4	130	328.6	275	800	900	960	1470	82	48	425	138	800	540
8LAA-UTE×YX350L	2472	836	201	130×2	402	320	920	1020	1080	1635	–	15	445	235	880	640
8LAA-UTE×MGN86E	2333	610	168	140	329	215	800	930	1010	1523	–	65	333	285	635	330
8LAA-UTE×MGN86EL	2323	605	171	140	321	230	980	1040	1120	1670	–	138	480	358	670	490
8LAA-UTE×MGN87L	2361	560	177	140	270	240	1130	1190	1270	1903.5	–	253.5	713	473.5	910	490

12LAA(M)-UTE1



Unit = mm

Model	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
12LAAM-UTE1	2583	–	–	–	–	–	–	–	–	1470	–	–	–	–	–	–
12LAA-UTE1×YX350E	2678	798	366.4	130	328.6	275	800	900	960	1470	82	90	425	138	800	540
12LAA-UTE1×YX350L	2916	836	201	130×2	402	320	920	1020	1080	163.5	–	15	445	235	880	640
12LAA-UTE1×MGN332	2850	770	279	110	408	280	800	930	1010	1470	–	15	265	235	530	330
12LAA-UTE1×MGN624	2840	760	274	140	373	280	1070	1190	1290	1740	–	163	550	383	750	450

ACCESSORIES

	Name of accessories		6LAA(M)-UTE	8LAA (M)-UTE	12LAA(M)-UTE1
Installation	Foundation plate for wooden bed		2 ●	2 ●	2 ●
	Chock liner for steel bed		6 △	6 △	6 △
	Bolt & Nut set for wooden bed		12 ●	12 ●	12 ●
	Bolt & Nut set for steel bed		12 △	12 △	12 △
	Leveling screw (jack bolt) for wooden bed		6 ●	6 ●	6 ●
	Alignment side jack bolt kit		8 ●	8 ●	8 ●
	Alignment adjusting shim	(Engine & Yanmar gear)	6 ●	6 ●	6 ●
		(Engine & Nico gear)	6 ●	6 ●	6 ●
	Distance piece for wooden bed (for YX-350E, L)		—	2 ●	2 ●
Air	Exhaust gas pipe		1 ●	2 ●	2 ●
	V-type funnel (for vee type arranged cylinder)		—	1 △	1 △
	Exhaust gas silencer (dry type)		1 △	2 △	2 △
	Exhaust flexible joint (turbo-charger outlet)		1 ●	2 ●	2 ●
	Breather hose with fittings		1 ●	1 ●	2 ●
	Engine room ventilator	(DC 24V 70m³/min)	1 △	2 △	2 △
	Intake air filter		1 ●	2 ●	2 ●
Fuel oil	Drain separator (mounted on hull)		1 ●	1 ●	2 ●
	Filter		1 ●	1 ●	1 ●
	Fuel oil feed pump (mechanical)		1 ●	1 ●	2 ●
	Fuel oil primary filter		1 △	1 △	1 △
	Fuel oil pipe	(tank to engine)	1 ●	1 ●	1 ●
		(engine to tank)	1 ●	1 ●	1 ●
Lubrication oil	Filter	(double)	1 ●	1 ●	—
		(fourth)	—	—	1 ●
	Evacuation hand pump		1 ●	1 ●	1 ●
	Centrifugal type oil cleaner		1 ●	1 ●	1 ●
	Wing pump primer		1 △	1 △	1 △
Cooling system	Heat exchanger		1 ●	1 ●	1 ●
	Kingston cock for wooden hull		1 ●	1 ●	1 ●
	Kingston valve for steel hull		1 △	1 △	1 △
	Raw water pipe & fittings		1 ●	1 ●	1 ●
	Raw water filter		1 ●	1 ●	1 ●
	Fresh water sub tank		1 ●	1 ●	1 ●
Bilge pump	Electric type (DC 24V)		1 △	1 △	1 △
	Rubber type (Yanmar marine gear driven)		1 △	1 △	1 △
Remote control	Control head (Yanmar original)	twin lever	1 ●	1 ●	1 ●
		single lever	1 △	1 △	1 △
	Push-pull cable (Yanmar original)	5m	2 △	2 △	2 △
		6m	2 △	2 △	2 △
		7m	2 △	2 △	2 △
		8.5m	2 △	2 △	2 △
		10m	2 ●	2 ●	2 ●

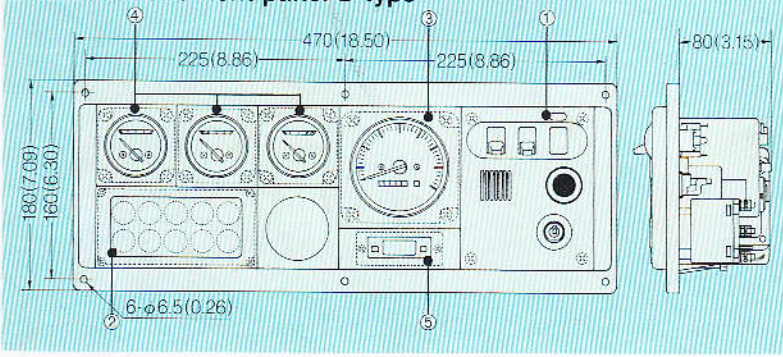
	Name of accessories		6LAA(M)-UTE	8LAA (M)-UTE	12LAA(M)-UTE1
Operation	Delux instrument panel (with alarm buzzer)		1 ●	1 ●	1 ●
	Wire harness	4m	1 △	1 △	1 △
		6m (3m×2)	1 △	1 △	1 △
		8m (4m×2)	1 △	1 △	1 △
		10m(3m×2.4m×1)	1 △	1 △	1 △
		12m (4m×3)	1 ●	1 ●	1 ●
	Exhaust gas thermometer (turbo inlet)		2 △	4 △	4 △
	Boost pressure gauge		1 ●	1 ●	1 ●
Front Power take-off device	Housing & mounting	(Yanmar original)	1 ●	1 ●	1 ●
		SAE No.3	1 △	1 △	1 △
	150P.C. Pulley with D/2 grooves for A type		1 △	1 △	1 △
	Flexible coupling (CG)		1 △	1 △	1 △
Electric device	Starting motor	5.5kW DC 24V	2 ●	2 ●	—
		7.0kW DC 24V	—	—	2 ●
	Charging Alternator	600W (24V/25A)	1 ●	—	—
		1kW (24V/25A)	—	1 ●	1 ●
	Battery switch		1 ●	1 ●	1 ●
	Battery (Local procurement)	12V 120AH	4	—	—
		12V 150AH	—	4	4
Others	Onboard spare parts kit		1 ●	1 ●	1 ●
	Daily maintenance tool kit		1 ●	1 ●	1 ●
	Workshop tool kit		1 △	1 △	1 △
	Exhaust gas turbocharger blower wash liquid		1 △	1 △	1 △
	Water jacket scale solvent		1 △	1 △	1 △
	Anti-corrosion agent for fresh water		1 △	1 △	1 △
	Operation manual		1 ●	1 ●	1 ●
	Service manual		1 △	1 △	1 △
	Parts book		1 △	1 △	1 △
Stern gear	Half coupling for intermediate shaft		1 ●	1 ●	1●
	Shaft & stern tube		1 △	1 △	1 △
	Propeller		1 △	1 △	1 △
Onboard spare parts	Anti-corrosion zinc	Heat exchanger	4 ●	4 ●	4 ●
		L.O. cooler	2 ●	2 ●	2 ●
		Air cooler	4 ●	4 ●	4 ●
		Marine gear (Yanmar)	2 ●	2 ●	2 ●
		Marine gear (Nico)	2 ●	2 ●	2 ●
	Raw water pump impeller		1 ●	1 ●	1 ●
	Intake air filter		1 ●	2 ●	2 ●
	Fuel oil filter element		2 ●	2 ●	4 ●
	Lube oil filter element		2 ●	2 ●	4 ●

Remark: ●: Standard △: Optional —: Not available

INSTRUMENT PANEL CONTAINS FOLLOWING ITEMS (STANDARD)

Unit: mm (in.)

Detail of instrument panel D-type



① Switch unit
- Alarm buzzer stop switch
- Illumination switch
- Alarm buzzer
- Starter switch

② Alarm lamp unit
- Battery not charging
- C.W. high temp.
- L.O. low pressure
- C.W. level
- L.O. filter clogged
- Clutch oil pressure

③ Tachometer unit
- Tachometer with hour meter

④ Sub meter unit
- Boost meter
- L.O. pressure meter
- C.W. temp. meter

⑤ Clock unit
- Clock

Note: All data subject to alteration without notice.

YANMAR DIESEL ENGINE CO.,LTD.

OVERSEAS OPERATIONS DIVISION

1-1, 2-chome, Yaesu, Chuo-ku, Tokyo 104, Japan
Telex:0222-4733 Telephone:03-3275-4933
Facsimile: 03-3272-0687 Cable: YANMAR TOKYO

60A2842 9212 (#) Printed in JAPAN

SHIP PARTICULAR

GENERAL

Nama Cabang	:	Selayar
Nama Kapal	:	KORMOMOLIN
No Register BKI	:	7010
No. IMO	:	8738419
Tanda Selar	:	GT.884 No. 1308/Ka
Tahun Pembuatan	:	1997
Call Sign	:	YDZK
Jenis Kapal	:	Ro-Ro Passanger Ferry
Galangan Pembuat	:	PT. ADILUHUNG SARANA SEGARA INDONESIA
Nama Pemilik	:	DEPARTEMEN PERHUBUNGAN DITJEN PERHUBUNGAN DARAT
Operator	:	PT. ASDP INDONESIA FERRY (PERSERO)
Bendera Kebangsaan	:	INDONESIA
Klasifikasi Kapal	:	BKI
Notasi Lambung	:	✠A100Ⓘ P
Notasi Mesin	:	✠SM

UKURAN

Loa	:	46	meter	Kecepatan Kapal			
LBP	:	40.6	meter	- V Design	:	11.7	knot
B	:	12	meter	- V Service	:	11	knot
H	:	3.1	meter	Tinggi Car Deck			
T	:	2.15	meter	- Main Deck	:	3.8	meter
GT	:	884		- Upper Deck	:	0	meter
NT	:	278					

PERMESINAN

Mesin	Merk	Type	Daya(HP)	RPM	Serial Number
Mesin Induk	YANMAR	8 LAA â€“ UTE	2 x 670	1850	0394 / 0393
Mesin Bantu	MERCEDES	6R099TE31	2 x 94	1500	

KAPASITAS MUAT

		Lower Deck		Main Deck		Upper Deck	
Crew	**Penumpang**	**Roda4**	**Roda4 +**	**Roda4**	**Roda4 +**	**Roda4**	**Roda4 +**
20	356	0	0	0	9	0	0

KAPASITAS TANGKI

Tangki BBM				Tangki Ballast			
- Tangki Induk	:	30	Ton	- Haluan	:	30	Ton
- Tangki Settling	:	N/A	Ton	- Tengah	:	N/A	Ton
- Tangki Service	:	2	Ton	- Buritan	:	30	Ton
Tangki Oli							
- Sumptank	:	1	Ton	Sludge Tank	:	N/A	Ton
- Storage Tank	:	N/A	Ton	Tangki Air Tawar	:	1	Ton

FASILITAS BONGKAR MUAT

Rampdoor Haluan				Rampdoor Sisi Kiri			
- Panjang	:	6	Meter	- Panjang	:	N/A	Meter
- Lebar	:	4	Meter	- Lebar	:	N/A	Meter
Rampdoor Buritan				Rampdoor Sisi Kanan			
- Panjang	:	6	Meter	- Panjang	:	N/A	Meter
- Lebar	:	4	Meter	- Lebar	:	N/A	Meter

Lampiran 6 harga komponen

data harga komponen	
oil pump	Rp12.070.000
cooler	Rp12.831.000
oil filter	Rp8.608.000

- Frekuensi breakdown oil pump

bulan	breakdown	p	runtime
1	2	0,059	0,059
2	3	0,088	0,176
3	2	0,059	0,176
4	4	0,118	0,471
5	3	0,088	0,441
6	2	0,059	0,353
7	2	0,059	0,412
8	4	0,118	0,941
9	3	0,088	0,794
10	4	0,118	1,176
11	2	0,059	0,647
12	3	0,088	1,059
total	**34**	**1,0**	**6,706**

- Frekuensi breakdown oil cooler

bulan	breakdown	p	Runtime
1	3	0,071	0,071
2	4	0,095	0,190
3	3	0,071	0,214
4	5	0,119	0,476
5	2	0,048	0,238
6	4	0,095	0,571
7	3	0,071	0,500
8	4	0,095	0,762
9	3	0,071	0,643
10	5	0,119	1,190
11	4	0,095	1,048
12	2	0,048	0,571
total	**42**	**1,0**	**6,476**

Tabel jenis breakdown oil cooler

Bulan	fb, pembersihan cooler	fb,pergantian zink
1	2	1
2	3	1
3	2	1
4	4	1
5	1	1
6	3	1
7	2	1
8	3	1
9	2	1
10	4	1
11	3	1
12	1	1
Total	**30**	**12**

Frekuensi breakdown oil filter

Bulan	breakdown	p	runtime
1	5	0.078	0.078
2	7	0.109	0.219
3	8	0.125	0.375
4	4	0.063	0.250
5	6	0.094	0.469
6	5	0.078	0.469
7	4	0.063	0.438
8	3	0.047	0.375
9	7	0.109	0.984
10	4	0.063	0.625
11	6	0.094	1.031
12	5	0.078	0.938
total	**64**	**1,0**	**6,250**

Tabel harga komponen oil cooler

jenis breakdown							
pembersihan cooler				pergantian zink			
nama item	jumlah item	harga	total	nama item	jumlah item	harga	total
o-ring seal G.155	2	Rp75.000	Rp150.000	**Z**ink, anti carrosif	2	Rp189.000	Rp378.000
o-ring seal G.165	2	Rp75.000	Rp150.000				
o-ring seal G.60	1	Rp25.000	Rp25.000				
o-ring seal G.50	1	Rp25.000	Rp25.000				
o-ring seal G.25	2	Rp25.000	Rp320.000				
Total			**Rp400.000**	**Total**			**Rp378.000**

Tabel harga komponen oil filter

jenis breakdown							
pembersihan saringan				pergantian filter			
nama item	jumlah item	Harga	total	nama item	jumlah item	harga	total
o-ring seal G.155	1	Rp30,000	Rp30,000	Lub oil filter	2	Rp235,000	Rp470,000
o-ring seal G.165	1	Rp25,000	Rp25,000	O-ring seal G	1	Rp30,000	Rp30,000
				O-ring seal G	1	Rp25,000	Rp25,000
Total			**Rp55.000**	**Total**			**Rp525.000**

Tabel jenis breakdown oil filter

bulan	fb, pembersihan saringan	fb,pergantian filter
1	5	0
2	6	1
3	8	0
4	3	1
5	5	1
6	5	0
7	3	1
8	3	0
9	6	1
10	3	1
11	6	0
12	4	1
total	**57**	**7**

Lampiran 4 Gambar Pengambilan Data