FAILURE CODE FC1 START Worn wearing ring **Algorithm SET VALUES &** Step 1: START **MEASURED VALUES** Step 2: **INPUT** SET VALUES: Q, P_d , i, λ , η , E_s , CVMEASURED VALUES: Q1, P_d1 , i1, $\lambda1$, $\eta1$, E_s1 , Step 3: IF(Q1 ≤ 54.8) AND (P_d1 ≤ 47) AND (i1 ≥18) Q1≤ 54.8 AND No P_d1≤ 47 AND i1≥18 AND η1≤ 53 AND (η 1 ≤ 53) AND (λ 1≥ 4.5) AND(E_s1≥ 2.5) AND λ1≥ 4.5 AND E_s1≥2.5 AND AND (CV1≥45%) then CV1≥ 45% SUM = $ABS[(Q-Q1)/Q + (P_d-P_d1)/P_d +$ $(i-i1)/i + (\lambda-\lambda 1)/\lambda + (\eta-\eta 1)/\eta + (E_s-E_s 1)/E_s$ Yes + (CV-CV1)/CV] AVG = SUM/7SUM **ELSE** AVG = SUM/7 GO TO Step 7 **ENDIF** IF(AVG>0)AND(AVG<0.8679) then Step 4: Yes PRINT GREEN 0 < AVG AND **GREEN** AVG < 0.8679 Stop **ENDIF** IF(AVG>=0.8679)AND(AVG<1.1731) then Step 5: No PRINT YELLOW Yes Stop 0.8679 ≤ AVG YELLOW AND AVG < 1.1731 **ENDIF** Step 6: IF(AVG>=1.1731) then PRINT RED No **ELSE** No Yes GO TO Step 4 **AVG** ≥ 1.1731 RED **ENDIF** Step 7: STOP **STOP**

Fig. Flowchart for Failure Code FC1

FAILURE CODE FC2 START Worn, rusted, defective bearing <u>Algorithm</u> **SET VALUES &** Step 1: START **MEASURED VALUES** Step 2: INPUT SET VALUES: i, λ , E_s , T_B MEASURED VALUES: i1, λ1, Es1, TB1 Step 3: IF(i1≥18) AND (λ1≥4.5) AND(E_s1≥2.5) AND (T_B1≥80) then No i1 ≥ 18 AND λ 1 ≥ 4.5 AND E_s1≥ 2.5 SUM =ABS[(i-i1)/i + $(\lambda-\lambda 1)/\lambda$ + $(E_s-E_s 1)/E_s$ + AND T_B ≥ 80 $(T_B-T_B1)/T_B]$ AVG = SUM/4**ELSE** Yes GO TO Step 7 **ENDIF SUM** AVG = SUM/4 Step 4: IF(AVG>0)AND(AVG<1.2022) then PRINT GREEN Stop **ENDIF** Yes 0 < AVG AND Step 5: IF(AVG>=1.2022)AND(AVG<1.5116) then **GREEN** AVG < 1.2022 PRINT YELLOW Stop No **ENDIF** IF(AVG>=1.5116) then Step 6: Yes 1.2022 =< AVG AND PRINT RED **YELLOW** AVG < 1.5116 **ELSE** GO TO Step 4 No **ENDIF** Step 7: STOP No Yes AVG >= 1.5116 **RED STOP**

Fig. Flowchart for Failure Code FC2

FAILURE CODE FC3 START Starvation at Pump suction/Insufficient suction volume **Algorithm SET VALUES & MEASURED VALUES** Step 1: **START** Step 2: **INPUT** SET VALUES: Q, P_d , i, λ , E_s , T_P , T_B , CVMEASURED VALUES: Q1, P_d1 , i1, $\lambda1$, E_s1 , T_P1 , T_B1, CV1 Q1 ≤ 54.8 AND Pd1 ≤ No 47 AND i1 \leq 15 AND $\lambda1 \geq$ 4.5 AND $E_s1 \geq$ Step 3: $IF(Q1 \le 54.8) AND (P_d1 \le 47) AND$ 2.5 AND T_P1 ≥ 300 AND T_B1 ≥ 80 AND CV1 ≥ (i1 ≤ 15) AND (λ1 ≥ 4.5) AND $(E_s1 ≥ 2.5)$ 45% AND ($T_P1 \ge 300$) AND ($T_B1 \ge 80$) AND (CV1 ≥ 45%) then Yes SUM = $ABS[(Q-Q1)/Q + (P_d-P_d1)/P_d +$ $(i-i1)/i + (\lambda-\lambda 1)/\lambda + (E_s-E_s 1)/E_s +$ SUM $(T_P - T_P 1)/T_P + (T_B - T_B 1)/T_B +$ AVG = SUM/8 (CV-CV1)/CV] AVG = SUM/8 **ELSE** Yes 0 < AVG AND GO TO Step 7 **GREEN** AVG < 0.7781 **ENDIF** IF(AVG>0)AND(AVG<0.7781) then Step 4: PRINT GREEN No Stop Yes **ENDIF** 0.7781=< AVG AND **YELLOW** AVG < 1.0317 IF(AVG>=0.7781)AND(AVG<1.0317) then Step 5: PRINT YELLOW No Stop **ENDIF** No Yes IF(AVG>=1.5116) then Step 6: AVG >= 1.0317 **RED** PRINT RED **ELSE** GO TO Step 4 **ENDIF** STOP

Fig. Flowchart for Failure Code FC3

FAILURE CODE FC4 START Internal rubbing **Algorithm SET VALUES &** Step 1: START **MEASURED VALUES** Step 2: INPUT SET VALUES: i, \(\lambda\), Es, Tp, MEASURED VALUES: i1, λ1, E_s1, T_P1 Step 3: IF(i1 \geq 18) AND (λ 1 \geq 4.5) AND (E_s1 \geq 2.5) AND $(T_P1 \ge 300)$ then No i1 \geq 18 AND λ 1 \geq 4.5 AND E_s1 \geq 2.5 AND $T_p \ge 300$ SUM = ABS $[(i-i1)/i + (\lambda-\lambda 1)/\lambda + (E_s-E_s 1)/E_s]$ $+ (T_P - T_P 1)/T_P$ AVG = SUM / 4 Yes **ELSE** GO TO Step 7 SUM **ENDIF** AVG = SUM/4 Step 4: IF(AVG>0)AND(AVG<1.2050) then PRINT GREEN Stop **ENDIF** Yes 0 < AVG AND **GREEN** Step 5: IF(AVG>=1.2050)AND(AVG<1.4978) then AVG < 1.2050 PRINT YELLOW Stop No **ENDIF** IF(AVG>=1.5116) then Yes 1.2050 =< AVG AND PRINT RED **YELLOW** AVG < 1.4978 **ELSE** GO TO Step 4 No **ENDIF** Step 7: STOP No Yes AVG >= 1.4978 **RED** STOP

Fig. Flowchart for Failure Code FC4