***ΤΕΧΝΗΤΗ ΝΟΗΜΟΣΥΝΗ***

***ΑΣΚΗΣΗ 3η***

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**1.1** Σκοπός της άσκησης είναι η υλοποίηση ενός έμπειρου συστήματος για διάγνωση συγκεκριμένων τύπου βλαβών που σχετίζονται με το σύστημα λίπανσης συγκεκριμένου τύπου κινητήρα. Η έμπειρη γνώση που απαιτείται για την υλοποίηση τους συστήματος δίνεται από τον οδηγό επισήμανσης λαθών (Fault Isolation Manual). Με χρήση του παραπάνω σύστημα έμπειρης γνώσης είναι δυνατό να εξαχθούν συμπεράσματα για το είδος της βλάβης , όπως και πιθανές λύσεις για την προκύπτουσα βλάβη, μέσω των απαντήσεων (ναι ή όχι) του μηχανικού σε σειρά ερωτήσεων του συστήματος.

Λόγω του μεγάλου όγκου της έμπειρης γνώσης που βρίσκεται στο FIM , υλοποιούμε το σύστημα μοντελοποιώντας την έμπειρη γνώση μόνο για συγκεκριμένους τύπους βλαβών (Oil Consumption & Oil Temperature).

**1.2** Τα δεδομένα λαμβάνονται κατά την λειτουργία του συστήματος της έμπειρης γνώσης σε μορφή καταφατικών ή μη απαντήσεων σε κατάλληλες ερωτήσεις που παράγει το σύστημα. Συνεπώς το σύστημα είναι κανό να παράγει κάποιο συμπέρασμα για πιθανό τρόπο επίλυσης κάποιας βλάβης , ύστερα από σειρά ερωτήσεων με τις οποίες θα αποκτήσει τα απαραίτητα δεδομένα/γνώση.

**1.3** Ο οδηγός (FIM) ουσιαστικά περιέχει διαγράμματα ροής ερωτήσεων που καταλήγουν σε πιθανές λύσεις των βλαβών , για κάθε κατηγορία βλάβης. Έτσι κάθε απάντηση σε κάποια ερώτηση οδηγεί στην εκτέλεση του κανόνα που αντιστοιχεί στην απάντηση αυτή (ναι / όχι) , ο οποίος περιέχει κάποια άλλη ερώτηση (που αναμένει απάντηση και αντιστοιχίζεται σε άλλο κανόνα) είτε εκτυπώνει μήνυμα πιθανούς λύσης του προβλήματος. Η ενεργοποίηση κάθε κανόνα γίνεται με την δημιουργία κάποιου γεγονότος από τον προηγούμενο κανόνα στο διάγραμμα ροής (assert (…)). Η μορφή της γνώσης καθιστά αναγκαίο να δημιουργηθεί ένας κανόνας για κάθε κόμβο του διαγράμματος ροής.

**1.4** Παραδείγματα εκτέλεσης για σενάριο ***BD***

CLIPS> (run)

ttt\*\*\*\*\*BOEING 747 FAULT ISOLATION EXPERT SYSTEM\*\*\*\*\*

tMAIN MENUt

1 - Oil consumption is high

2 - Oil quantity indicator is malfunctioning

3 - Oil pressure is abnormal or indicator is malfunctioning

4 - Oil filter bypass light is illuminated

5 - Oil temperature is abnormal or indicator is malfunctioning

6 - Breather temperature is high

7 - Engine was shutdown in flight

8 - Unlisted engine oil fault

tWhich of the above were observed during the flight? >1

Which engine is malfuctioning? (1,2,3,4,0) >2

Are there any other abnormal oil systems? [yes,no] >

no

Examine turbine exhaust area for evidence of oil loss per Visual Check 1, 79-01-10. Is oil loss occuring? [yes,no] >

yes

Identify source of oil loss per Visual Check 1, 79-01-10. Is oil loss due to leakage from rear cover of No. 4 bearing compartment? [yes,no] >

no

Is oil loss due to leakage from oil pressure supply line or oil scavenge line of No. 4 bearing compartment? [yes,no] >

no

Is oil loss due to a clogged or loose oil scavenge line or a failed scavenge pump? [yes,no] >

no

***Replace engine. MM 71-00***

*ttt\*\*\*\*\*BOEING 747 FAULT ISOLATION EXPERT SYSTEM\*\*\*\*\**

*tMAIN MENUt*

*1 - Oil consumption is high*

*2 - Oil quantity indicator is malfunctioning*

*3 - Oil pressure is abnormal or indicator is malfunctioning*

*4 - Oil filter bypass light is illuminated*

*5 - Oil temperature is abnormal or indicator is malfunctioning*

*6 - Breather temperature is high*

*7 - Engine was shutdown in flight*

*8 - Unlisted engine oil fault*

*tWhich of the above were observed during the flight? >1*

*Which engine is malfuctioning? (1,2,3,4,0) >4*

*Are there any other abnormal oil systems? [yes,no] >*

*no*

*Examine turbine exhaust area for evidence of oil loss per Visual Check 1, 79-01-10. Is oil loss occuring? [yes,no] >*

*no*

*Examine main gearbox drains (MM 71-71-00) for leakage. Is excessive oil present? [yes,no] >*

*no*

*Check that PT3 water drain plug is installed per Visual Check 9, 71-01-10. Is plug missing? [yes,no] >*

*yes*

***Install drain plug.***

Παραδείγματα εκτέλεσης για σενάριο ***BE***

*ttt\*\*\*\*\*BOEING 747 FAULT ISOLATION EXPERT SYSTEM\*\*\*\*\**

*tMAIN MENUt*

*1 - Oil consumption is high*

*2 - Oil quantity indicator is malfunctioning*

*3 - Oil pressure is abnormal or indicator is malfunctioning*

*4 - Oil filter bypass light is illuminated*

*5 - Oil temperature is abnormal or indicator is malfunctioning*

*6 - Breather temperature is high*

*7 - Engine was shutdown in flight*

*8 - Unlisted engine oil fault*

*tWhich of the above were observed during the flight? >1*

*Which engine is malfuctioning? (1,2,3,4,0) >1*

*Are there any other abnormal oil systems? [yes,no] >*

*yes*

*Examine turbine exhaust area for evidence of oil loss per Visual Check 1, 79-01-10. Is oil loss occuring? [yes,no] >*

*yes*

*Identify source of oil loss per Visual Check 1, 79-01-10. Is oil loss due to leakage from rear cover of No. 4 bearing compartment? [yes,no] >*

*yes*

***Replace engine. MM 71-00-02***

*ttt\*\*\*\*\*BOEING 747 FAULT ISOLATION EXPERT SYSTEM\*\*\*\*\**

*tMAIN MENUt*

*1 - Oil consumption is high*

*2 - Oil quantity indicator is malfunctioning*

*3 - Oil pressure is abnormal or indicator is malfunctioning*

*4 - Oil filter bypass light is illuminated*

*5 - Oil temperature is abnormal or indicator is malfunctioning*

*6 - Breather temperature is high*

*7 - Engine was shutdown in flight*

*8 - Unlisted engine oil fault*

*tWhich of the above were observed during the flight? >1*

*Which engine is malfuctioning? (1,2,3,4,0) >4*

*Are there any other abnormal oil systems? [yes,no] >*

*yes*

*Examine turbine exhaust area for evidence of oil loss per Visual Check 1, 79-01-10. Is oil loss occuring? [yes,no] >*

*no*

*Examine main gearbox drains (MM 71-71-00) for leakage. Is excessive oil present? [yes,no] >*

*no*

*Check that PT3 water drain plug is installed per Visual Check 9, 71-01-10. Is plug missing? [yes,no] >*

*no*

*Examine external plumbing, main gearbox and angle gearbox for obvious leakage per Visual Check 2, 79-01-10. Is obvious leakage present? [yes,no] >*

*no*

*Perform oil system static leak check per Engine Check 1, 79-01-20 and/or oil system monitoring leak check per Engine Check 2, 79-01-20. Was source of leakage found? [yes,no] >*

*yes*

***Refer to Engine Check 1 and/or engine check 2 for corrective action***

Παραδείγματα εκτέλεσης για σενάριο ***DF***

*ttt\*\*\*\*\*BOEING 747 FAULT ISOLATION EXPERT SYSTEM\*\*\*\*\**

*tMAIN MENUt*

*1 - Oil consumption is high*

*2 - Oil quantity indicator is malfunctioning*

*3 - Oil pressure is abnormal or indicator is malfunctioning*

*4 - Oil filter bypass light is illuminated*

*5 - Oil temperature is abnormal or indicator is malfunctioning*

*6 - Breather temperature is high*

*7 - Engine was shutdown in flight*

*8 - Unlisted engine oil fault*

*tWhich of the above were observed during the flight? >5*

*Which engine is malfuctioning? (1,2,3,4,0) >2*

*Is flight engineer's panel oil temperature abnormal? [yes,no] >*

*yes*

*Is flight engineer's panel oil temperature abnormally high? [yes,no] >*

*yes*

*Open eng oil temp and press circuit breaker on P6 panel. Observe oil temperature indication. Does indicator drive below -40 C? [yes,no] >*

*no*

***Replace oil temperature indicator N18, N19, N20, or N21. MM 79-34-02***

*ttt\*\*\*\*\*BOEING 747 FAULT ISOLATION EXPERT SYSTEM\*\*\*\*\**

*tMAIN MENUt*

*1 - Oil consumption is high*

*2 - Oil quantity indicator is malfunctioning*

*3 - Oil pressure is abnormal or indicator is malfunctioning*

*4 - Oil filter bypass light is illuminated*

*5 - Oil temperature is abnormal or indicator is malfunctioning*

*6 - Breather temperature is high*

*7 - Engine was shutdown in flight*

*8 - Unlisted engine oil fault*

*tWhich of the above were observed during the flight? >5*

*Which engine is malfuctioning? (1,2,3,4,0) >2*

*Is flight engineer's panel oil temperature abnormal? [yes,no] >*

*yes*

*Is flight engineer's panel oil temperature abnormally high? [yes,no] >*

*yes*

*Open eng oil temp and press circuit breaker on P6 panel. Observe oil temperature indication. Does indicator drive below -40 C? [yes,no] >*

*yes*

*Disconnect oil temperature bulb electrical connector, T140. Observe oil temperature indication. Does indicator drive above +170- C? [yes,no] >*

*yes*

*Attach decade resistor to pins 1 and 3 of electrical plug disconnected from oil temperature bulb. Set decade resistor to the following values:*

*Decade Resistor Ohms Indicator Reading*

*-------------------- -----------------*

*129 100 2 deg C*

*147 140 4 deg C*

*162 170 4 deg C*

*Observe oil temperature indication. Does indicator reading correspond to listed values? [yes,no] >*

*yes*

*Measure temperature of fuel/oil cooler adjacent to oil temperature bulb. Measure resistance between electrical terminals on bulb T426. Resistance should be as follows:*

*Temperature (C) Resistance (Ohms)*

*--------------- -----------------*

*-20 83.77 0.40*

*-10 87.04 0.40*

*0 90.38 0.40*

*10 93.80 0.40*

*20 97.31 0.40*

*30 100.91 0.40*

*40 104.60 0.40*

*50 108.39 0.40*

*60 112.28 0.50*

*70 116.27 0.50*

*Interpolate resistance values for temperatures between those given. Do temperature and resistance values agree? [yes,no] >*

*yes*

***Replace fuel/oil cooler flow control thermostat (bypass valve). MM 79-21-05.***

**2.** Ακολουθεί ο πηγαίος κώδικας της άσκησης σε CLIPS:

(deffacts startup (menu-op start))

(defrule main-menu

(menu-op start)

?fact <- (menu-op start)

=>

(printout t t t t "\*\*\*\*\*BOEING 747 FAULT ISOLATION EXPERT SYSTEM\*\*\*\*\*" crlf)

(printout t t "MAIN MENU" t crlf)

(printout t "1 - Oil consumption is high" crlf)

(printout t "2 - Oil quantity indicator is malfunctioning" crlf)

(printout t "3 - Oil pressure is abnormal or indicator is malfunctioning" crlf)

(printout t "4 - Oil filter bypass light is illuminated" crlf)

(printout t "5 - Oil temperature is abnormal or indicator is malfunctioning" crlf)

(printout t "6 - Breather temperature is high" crlf)

(printout t "7 - Engine was shutdown in flight" crlf)

(printout t "8 - Unlisted engine oil fault" crlf)

(printout t t "Which of the above were observed during the flight? >" )

(assert (observed-problem-number (read)) )

(printout t crlf)

(retract ?fact)

)

(defrule engine-number

(menu-op engine-num)

?fact <- (menu-op engine-num)

=>

(printout t "Which engine is malfuctioning? (1,2,3,4,0) >")

(assert (engine-num (read)))

(printout t crlf)

(retract ?fact)

)

;------------------------------------------------------------------------------------------------------

(defrule oil-consumption

(observed-problem-number 1)

=>

(assert (observed-problem-name high\_consumption))

(assert (menu-op engine-num))

)

(defrule oil-qty-ind

(observed-problem-number 2)

=>

(printout t "possible fault not listed")

(printout t crlf)

)

(defrule oil-pressure

(observed-problem-number 3)

=>

(printout t "possible fault not listed")

(printout t crlf)

)

(defrule oil-filter-bypass

(observed-problem-number 4)

=>

(printout t "possible fault not listed")

(printout t crlf)

)

(defrule oil-temperature

(observed-problem-number 5)

=>

(assert (observed-problem-name oil\_temp))

(assert (menu-op engine-num))

)

(defrule breather-temperature

(observed-problem-number 6)

=>

(printout t "possible fault not listed")

(printout t crlf)

)

(defrule shutdown-in-flight

(observed-problem-number 7)

=>

(printout t "possible fault not listed")

(printout t crlf)

)

(defrule not\_listed

(observed-problem-number 8)

=>

(printout t "possible fault not listed")

(printout t crlf)

)

;------------------------------------------------------------------------------------------------------

(defrule high-oil-consumption

(observed-problem-name high\_consumption)

(engine-num ?entry)

=>

(assert (error-code (sym-cat 79-01-BA-0 ?entry)))

(printout t "Are there any other abnormal oil systems? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (error-code (sym-cat 79-01-BE)))

else (assert (error-code (sym-cat 79-01-BD)))

)

)

(defrule BD-BE

(or (error-code 79-01-BE) (error-code 79-01-BD))

=>

(printout t "Examine turbine exhaust area for evidence of oil loss per Visual Check 1, 79-01-10. Is oil loss occuring? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 2))

else (assert (bdbe 1))

)

)

(defrule bdbe1

(bdbe 1)

?fact <- (bdbe 1)

=>

(printout t "Examine main gearbox drains (MM 71-71-00) for leakage. Is excessive oil present? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 14))

else (assert (bdbe 15))

)

(retract ?fact)

)

(defrule bdbe2

(bdbe 2)

?fact <- (bdbe 2)

=>

(printout t "Identify source of oil loss per Visual Check 1, 79-01-10. Is oil loss due to leakage from rear cover of No. 4 bearing compartment? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 4))

else (assert (bdbe 3))

)

(retract ?fact)

)

(defrule bdbe3

(bdbe 3)

?fact <- (bdbe 3)

=>

(printout t "Is oil loss due to leakage from oil pressure supply line or oil scavenge line of No. 4 bearing compartment? [yes,no] >" crlf )

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 5))

else (assert (bdbe 6))

)

(retract ?fact)

)

(defrule bdbe4or9

(or (bdbe 4) (bdbe 9))

?fact <- (bdbe ?)

=>

(printout t " Replace engine. MM 71-00-02 ",crlf )

(retract ?fact)

)

(defrule bdbe5

(bdbe 5)

?fact <- (bdbe 5)

=>

(printout t " Remove and clean or replace oil pressure supply tube and/or oil scavenge tube as required. MM 72-53-00." crlf)

(retract ?fact)

)

(defrule bdbe6

(bdbe 6)

?fact <- (bdbe 6)

=>

(printout t "Is oil loss due to a clogged or loose oil scavenge line or a failed scavenge pump? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 8))

else (assert (bdbe 9))

)

(retract ?fact)

)

(defrule bdbe8

(bdbe 8)

?fact <- (bdbe 8)

=>

(printout t " Remove and clean or replace oil scavenge tube as necessary. MM 72-53-00. Replace scavenge pump if required. MM 72-61-21." crlf )

(retract ?fact)

)

(defrule bdbe14

(bdbe 14)

?fact <- (bdbe 14)

=>

(printout t "Identify leaking drain line source (MM 71-71-00) Was source of leakage from the fuel/oil cooler? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 16))

else (assert (bdbe 17))

)

(retract ?fact)

)

(defrule bdbe15

(bdbe 15)

?fact <- (bdbe 15)

=>

(printout t "Check that PT3 water drain plug is installed per Visual Check 9, 71-01-10. Is plug missing? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 19A))

else (assert (bdbe 19B))

)

(retract ?fact)

)

(defrule bdbe16

(bdbe 16)

?fact <- (bdbe 16)

=>

(printout t " Replace fuel/oil cooler (MM 79-21-01)." ,crlf)

(retract ?fact)

)

(defrule bdbe17

(bdbe 17)

?fact <- (bdbe 16)

=>

(printout t " Remove applicable component and check both component and drive pad seal. Replace component and/or drive seal as follows:",crlf)

(printout t " Component Seal Replacement Ref",crlf)

(printout t " --------- --------------------",crlf)

(printout t " Generator (MM 24-21-01) MM 72-61-08",crlf)

(printout t " Fuel Pump (MM 73-11-01) MM 72-61-11",crlf)

(printout t " Hydraulic Pump (MM 29-11-05) MM 72-61-09",crlf)

(printout t " Starter (MM 80-11-01) MM 72-61-06",crlf)

(printout t " Constant Speed Drive MM 72-61-07",crlf)

(printout t " (MM 24-11-01)",crlf)

(retract ?fact)

)

(defrule bdbe19A

(bdbe 19A)

?fact <- (bdbe 19A)

=>

(printout t "Install drain plug." ,crlf)

(retract ?fact)

)

(defrule bdbe19B

(bdbe 19B)

?fact <- (bdbe 19B)

=>

(printout t "Examine external plumbing, main gearbox and angle gearbox for obvious leakage per Visual Check 2, 79-01-10. Is obvious leakage present? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 20))

else (assert (bdbe 21))

)

(retract ?fact)

)

(defrule bdbe20

(bdbe 20)

?fact <- (bdbe 20)

=>

(printout t "Is leakage from oil pressure and/or oil scavenge lines? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 22))

else (assert (bdbe 23))

)

(retract ?fact)

)

(defrule bdbe22

(bdbe 22)

?fact <- (bdbe 22)

=>

(printout t "Is leakage from No. 3 bearing oil scavenge tube connections? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 24))

else (assert (bdbe 25))

)

(retract ?fact)

)

(defrule bdbe23

(bdbe 23)

?fact <- (bdbe 23)

=>

(printout t "Is leakage from breather lines? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 28))

else (assert (bdbe 29))

)

(retract ?fact)

)

(defrule bdbe28

(bdbe 28)

?fact <- (bdbe 28)

=>

(printout t "Is leakage from No. 1 and 2 bearing breather manifold and/or No. 3 bearing breather manifold? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 30))

else (assert (bdbe 31))

)

(retract ?fact)

)

(defrule bdbe24

(bdbe 24)

?fact <- (bdbe 24)

=>

(printout t "Repair No. 3 bearing oil scavenge tube connections as required. MM 79-21-03 AR." crlf)

(retract ?fact)

)

(defrule bdbe24

(bdbe 24)

?fact <- (bdbe 24)

=>

(printout t "Repair No. 3 bearing oil scavenge tube connections as required. MM 79-21-03 AR." crlf)

(retract ?fact)

)

(defrule bdbe28or31

(or (bdbe 28) (bdbe 31))

?fact <- (bdbe ?)

=>

(printout t "Replace Engine. MM 71-00-02" crlf)

(retract ?fact)

)

(defrule bdbe30

(bdbe 30)

?fact <- (bdbe 30)

=>

(printout t "Replace No. 1 and 2 bearing breather manifold and/or No. 3 bearing breather manifold as required. MM 79-21-04 R/I." crlf)

(retract ?fact)

)

(defrule bdbe29

(bdbe 29)

?fact <- (bdbe 29)

=>

(printout t "Is leakage from oil instrumentation lines? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 33))

else (assert (bdbe 34))

)

(retract ?fact)

)

(defrule bdbe34

(bdbe 34)

?fact <- (bdbe 34)

=>

(printout t "Is leakage from N2 manual crank on main gearbox? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 35))

else (assert (bdbe 36))

)

(retract ?fact)

)

(defrule bdbe36

(bdbe 36)

?fact <- (bdbe 36)

=>

(printout t "Is leakage from angle gearbox? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 38))

else (assert (bdbe 39))

)

(retract ?fact)

)

(defrule bdbe39

(bdbe 39)

?fact <- (bdbe 39)

=>

(printout t "Is leakage from main gearbox? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 41))

else (assert (bdbe 42))

)

(retract ?fact)

)

(defrule bdbe33

(bdbe 33)

?fact <- (bdbe 33)

=>

(printout t "Replace Engine. MM 71-00-02" crlf)

(retract ?fact)

)

(defrule bdbe35

(bdbe 35)

?fact <- (bdbe 35)

=>

(printout t "Remove N2 manual crank pad and install new o-ring and gasket (if applicable). MM 72-00-00 MP." crlf)

(retract ?fact)

)

(defrule bdbe38

(bdbe 38)

?fact <- (bdbe 38)

=>

(printout t "Replace angle gearbox. MM 72-61-01 R/I." crlf)

(retract ?fact)

)

(defrule bdbe41

(bdbe 41)

?fact <- (bdbe 41)

=>

(printout t "Replace main gearbox. MM 72-61-02 R/I." crlf)

(retract ?fact)

)

(defrule bdbe42

(bdbe 42)

?fact <- (bdbe 42)

=>

(printout t "Replace Engine. MM 71-00-02" crlf)

(retract ?fact)

)

(defrule bdbe21

(bdbe 21)

?fact <- (bdbe 21)

=>

(printout t "Perform oil system static leak check per Engine Check 1, 79-01-20 and/or oil system monitoring leak check per Engine Check 2, 79-01-20. Was source of leakage found? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 45))

else (assert (bdbe 46))

)

(retract ?fact)

)

(defrule bdbe46

(bdbe 46)

?fact <- (bdbe 46)

=>

(printout t "Check fuel pump hydraulic stage pressure per Engine Check 2, 71-01-20. Is pressure within limits? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 49))

else (assert (bdbe 48))

)

(retract ?fact)

)

(defrule bdbe49

(bdbe 49)

?fact <- (bdbe 49)

=>

(printout t "Check ground idle speed. MM 71-00-00 A/T, Test No. 9. Is ground idle speed low? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 51))

else (assert (bdbe 52))

)

(retract ?fact)

)

(defrule bdbe52

(bdbe 52)

?fact <- (bdbe 52)

=>

(printout t ">From idle power, advance thrust level slowly to increase N2 RPM by 10+ACU-. Did N1 increase at least 10+ACU- also? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (bdbe 54))

else (assert (bdbe 55))

)

(retract ?fact)

)

(defrule bdbe45

(bdbe 45)

?fact <- (bdbe 45)

=>

(printout t "Refer to Engine Check 1 and/or engine check 2 for corrective action." crlf)

(retract ?fact)

)

(defrule bdbe48

(bdbe 48)

?fact <- (bdbe 48)

=>

(printout t "Replace fuel pump. MM 73-11-01." crlf)

(retract ?fact)

)

(defrule bdbe51

(bdbe 51)

?fact <- (bdbe 51)

=>

(printout t "Adjust ground idle speed. MM 71-00-00 A/T, Test No. 9." crlf)

(retract ?fact)

)

(defrule bdbe54

(bdbe 54)

?fact <- (bdbe 54)

=>

(printout t "Replace Evc. MM 75-31-01." crlf)

(retract ?fact)

)

(defrule bdbe55

(bdbe 55)

?fact <- (bdbe 55)

=>

(printout t "AThe following are infrequent causes of this fault:

1. Faulty main gearbox deaerator Ref Engine Check 3, 79-01-20 for resolution

2. PT3 manifold leaks Ref Visual Check 8, 71-01-10 for resolution

3. No. 1 and 2 bearing compartment leaks Replace Engine (MM 71-00-02)" crlf)

(retract ?fact)

)

;------------------------------------------------------------------------------------------------

(defrule abnormal-oil-temperature

(observed-problem-name oil\_temp)

(engine-num ?entry)

=>

(assert (error-code (sym-cat 79-01-BA-0 ?entry)))

(printout t "Is flight engineer's panel oil temperature abnormal? [yes,no] >" crlf)

(bind ?answer1 (read))

(printout t "Is flight engineer's panel oil temperature abnormally high? [yes,no] >" crlf)

(bind ?answer2 (read))

(if (and (eq ?answer1 yes) (eq ?answer2 yes))

then (assert (error-code (sym-cat 79-01-DF)))

else (printout t "possible fault not listed" crlf)

)

)

(defrule DF

(error-code 79-01-DF)

=>

(printout t "Open eng oil temp and press circuit breaker on P6 panel. Observe oil temperature indication. Does indicator drive below -40 C? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (df 1))

else (assert (df 2))

)

)

(defrule df1

(df 1)

?fact <- (df 1)

=>

(printout t "Disconnect oil temperature bulb electrical connector, T140. Observe oil temperature indication. Does indicator drive above +170- C? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (df 12))

else (assert (df 9))

)

(retract ?fact)

)

(defrule df9

(df 9)

?fact <- (df 9)

=>

(printout t "Replace oil temperature indicator N18, N19, N20, or N21. MM 79-34-02. Observe oil temperature indication. Does indicator drive above +170- C? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer no)

then (assert (df 10))

)

(retract ?fact)

)

(defrule df12

(df 12)

?fact <- (df 12)

=>

(printout t "Attach decade resistor to pins 1 and 3 of electrical plug disconnected from oil temperature bulb. Set decade resistor to the following values:

Decade Resistor Ohms Indicator Reading

-------------------- -----------------

129 100 2 deg C

147 140 4 deg C

162 170 4 deg C

Observe oil temperature indication. Does indicator reading correspond to listed values? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (df 17))

else (assert (df 16))

)

(retract ?fact)

)

(defrule df2

(df 2)

?fact <- (df 2)

=>

(printout t "Replace oil temperature indicator N18, N19, N20, or N21. MM 79-34-02." crlf)

(retract ?fact)

)

(defrule df10

(df 10)

?fact <- (df 10)

=>

(printout t "Repair electrical wiring between oil temperature bulb electrical connector and oil temperature indicator. WM 79-34-11." crlf)

(retract ?fact)

)

(defrule df16

(df 16)

?fact <- (df 16)

=>

(printout t "Replace oil temperature indicator N18, N19, N20, or N21. MM 79-34-02. Observe oil temperature indication. Does indicator drive above +170- C?

Attach decade resistor to pins 1 and 3 of electrical plug disconnected from oil temperature bulb. Set decade resistor to the following values:

Decade Resistor Ohms Indicator Reading

-------------------- -----------------

129 100 2 deg C

147 140 4 deg C

162 170 4 deg C

Observe oil temperature indication. Does indicator reading correspond to listed values?

[yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer no)

then (assert (df 22))

)

(retract ?fact)

)

(defrule df17

(df 17)

?fact <- (df 17)

=>

(printout t "Measure temperature of fuel/oil cooler adjacent to oil temperature bulb. Measure resistance between electrical terminals on bulb T426. Resistance should be as follows:

Temperature (C) Resistance (Ohms)

--------------- -----------------

-20 83.77 0.40

-10 87.04 0.40

0 90.38 0.40

10 93.80 0.40

20 97.31 0.40

30 100.91 0.40

40 104.60 0.40

50 108.39 0.40

60 112.28 0.50

70 116.27 0.50

Interpolate resistance values for temperatures between those given. Do temperature and resistance values agree? [yes,no] >" crlf)

(bind ?answer (read))

(if (eq ?answer yes)

then (assert (df 27))

else (assert (df 26))

)

(retract ?fact)

)

(defrule df22

(df 22)

?fact <- (df 22)

=>

(printout t "Repair electrical wiring between oil temperature bulb electrical connector T426 and oil temperature indicator. WM 79-34-11." crlf)

(retract ?fact)

)

(defrule df26

(df 26)

?fact <- (df 26)

=>

(printout t "Replace oil temperature bulb T426. MM 79-34-01." crlf)

(retract ?fact)

)

(defrule df27

(df 27)

?fact <- (df 27)

=>

(printout t "Replace fuel/oil cooler flow control thermostat (bypass valve). MM 79-21-05." crlf)

(retract ?fact)

)