

# NEW

From DSI International

*eXpress* <sup>64</sup>



Better Stronger Faster



*eXpress*



**CAPTURE**  
**RTAT**

**Knowledge**

*and*

**Diagnostic**

**DSI**  
**Workbench**





# Generate Diagnostics

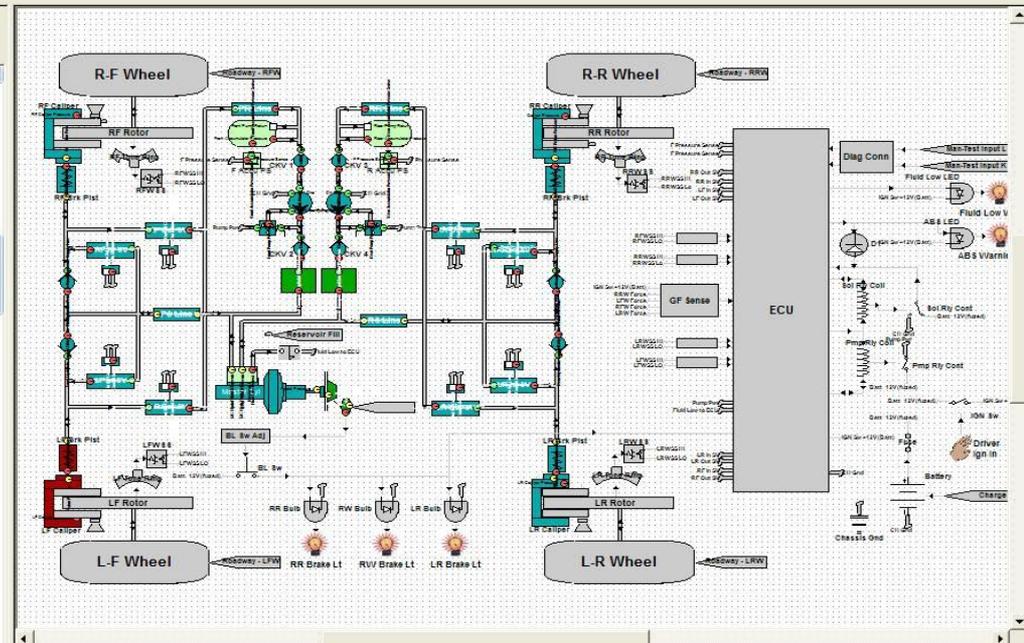
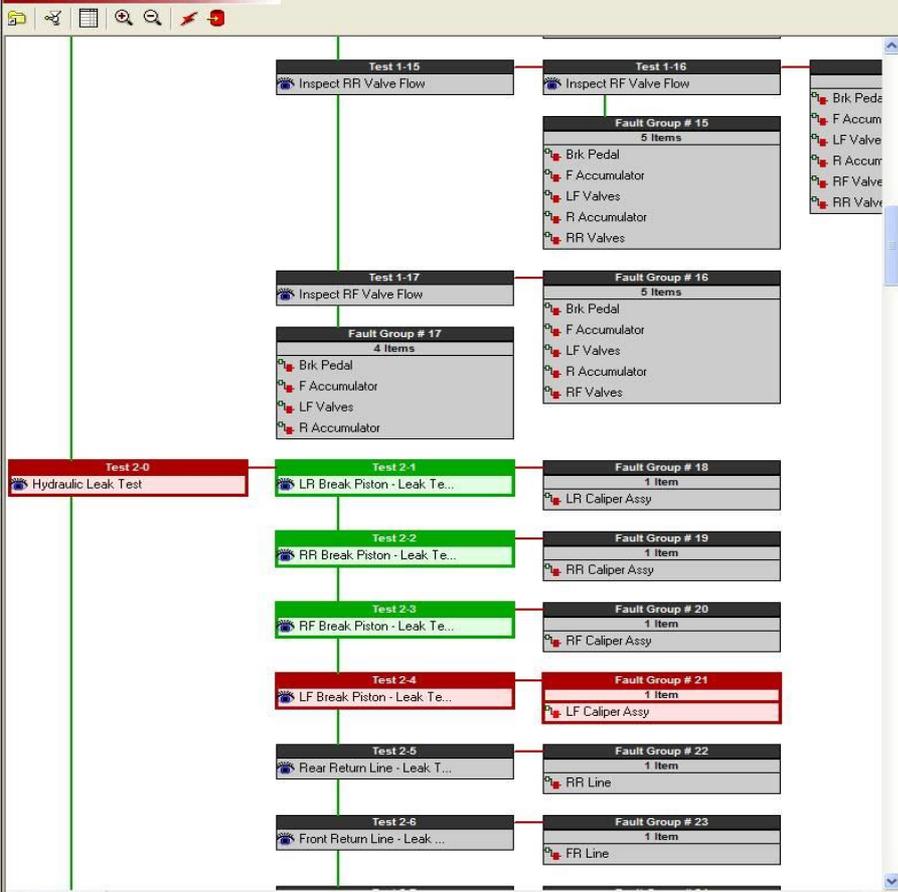
eXpress - [DiagnosticsDoc2:1]

File Reports View Window Help

All Design Errors

Go to Error << >> Explain

Diagnostic Study



Isolation Statistics

Multiple Fault Statistics

FG Size	Count	FP	Cum
1	69	76.13	76.13
2	6	7.58	83.72
3	3	1.46	85.18
4	1	0.54	85.72
5	5	7.75	93.46
6	4	4.80	98.26
7	1	1.74	100.00

Fault Group Summary Statistics

Probability of Detection	100.00%
Probability of Isolation	76.13%
Expected Fault Group Size	1.78
Isolation Effectiveness	56.33

selected

NUM

# Export Diagnostics

DiagML Options

Export DiagML for the DSI Workbench

New Configuration | Update Configuration | Remove Configuration

- Design Data
  - Design Comments
  - Items
    - Hierarchical Context (in Context field)
    - Description
    - Ports
    - Appearance
    - F/FMs per Object on Multi-Object Items
  - Attributes
    - Cost
    - Equipment Type
    - LCN
    - Part Number
    - Time
  - Relative Failure Probability
- I/O Objects (all)
  - Hierarchical Context (in Context field)
  - Description
  - Ports
  - Appearance
  - Annotations
  - Functions

XML Encoding: -Encoding scheme not specified-

OK Cancel

Diagnostic Study

Test 1: Inspect RR Valve F...

Test 1: Inspect RF Valve F...

Fault Group #4 Item

- Brk Pedal
- F Accumulator
- LF Valves
- R Accumulator

Test 2-0: Hydraulic Leak Test

Test 2-1: LR Break Piston - Leak Te...

Fault Group #18: 1 Item

- LR Caliper Assy

Test 2-2: RR Break Piston - Leak Te...

Fault Group #19: 1 Item

- RR Caliper Assy

Test 2-3: RF Break Piston - Leak Te...

Fault Group #20: 1 Item

- RF Caliper Assy

Test 2-4: LF Break Piston - Leak Te...

Fault Group #21: 1 Item

- LF Caliper Assy

Test 2-5: Rear Return Line - Leak T...

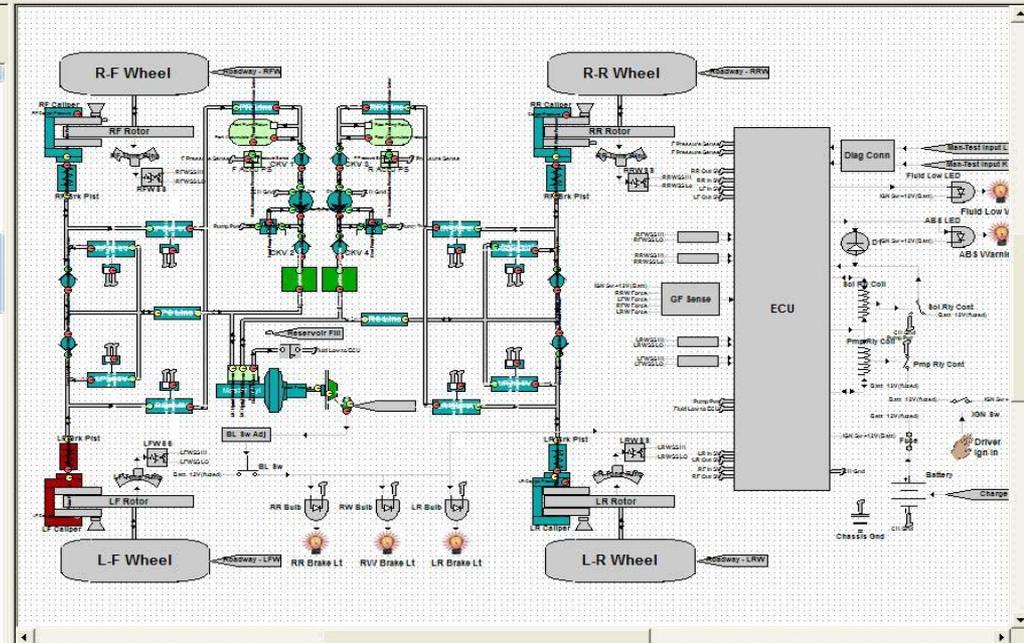
Fault Group #22: 1 Item

- RR Line

Test 2-6: Front Return Line - Leak ...

Fault Group #23: 1 Item

- FR Line



Isolation Statistics

Multiple Fault Statistics

FG Size	Count	FP	Cum
1	69	76.13	76.13
2	6	7.58	83.72
3	3	1.46	85.18
4	1	0.54	85.72
5	5	7.75	93.46
6	4	4.80	98.26
7	1	1.74	100.00

Fault Group Summary Statistics

Probability of Detection	100.00%
Probability of Isolation	76.13%
Expected Fault Group Size	1.78
Isolation Effectiveness	56.33

*eXpress*



**RTAT**



*DSI  
Workbench*

**MERGE**  
Images  
*and*  
Documents

File Project Help

DiagML Import Publish

Braking System

Item Details Documents References Web Publishing

Description:

Diagnostics

Import Merge Remove

Directory:  ...

Diagnostic:  ...

Design File:  ...

Automated Testing

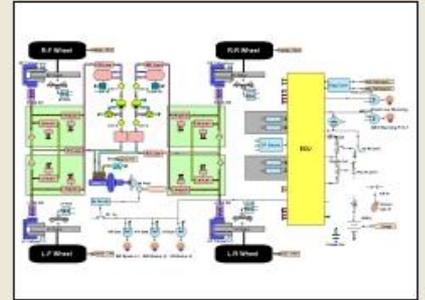
Test Results File:  ...

Always prompt for filename.

Thumbnail Image

Display Thumbnail

Image:  ...



Braking System



Braking System

Document Details

Description:

Filename: Automotive Braking System 511\ ...

Document Overlays

Filename	Page
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Document List

- Automotive Braking System 511  
Braking System

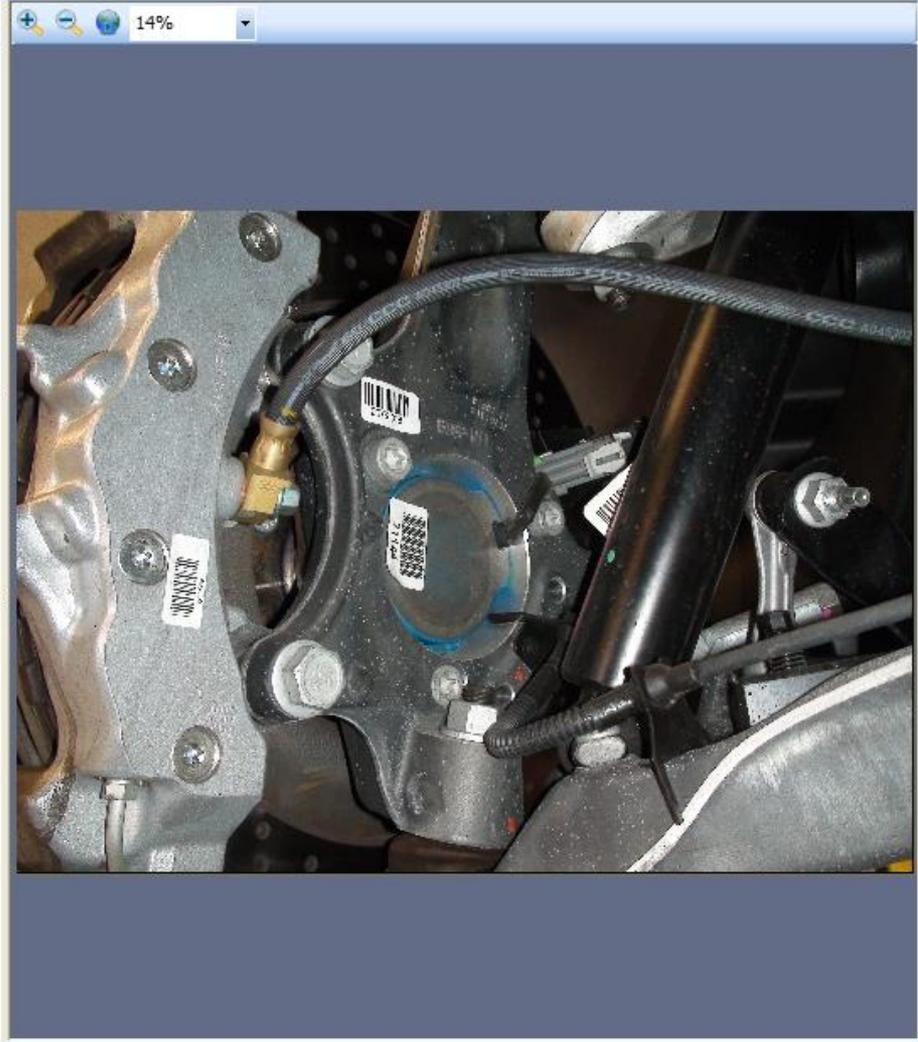
Document Details

Description:

Filename: Automotive Braking System 511\ ...

Document Overlays

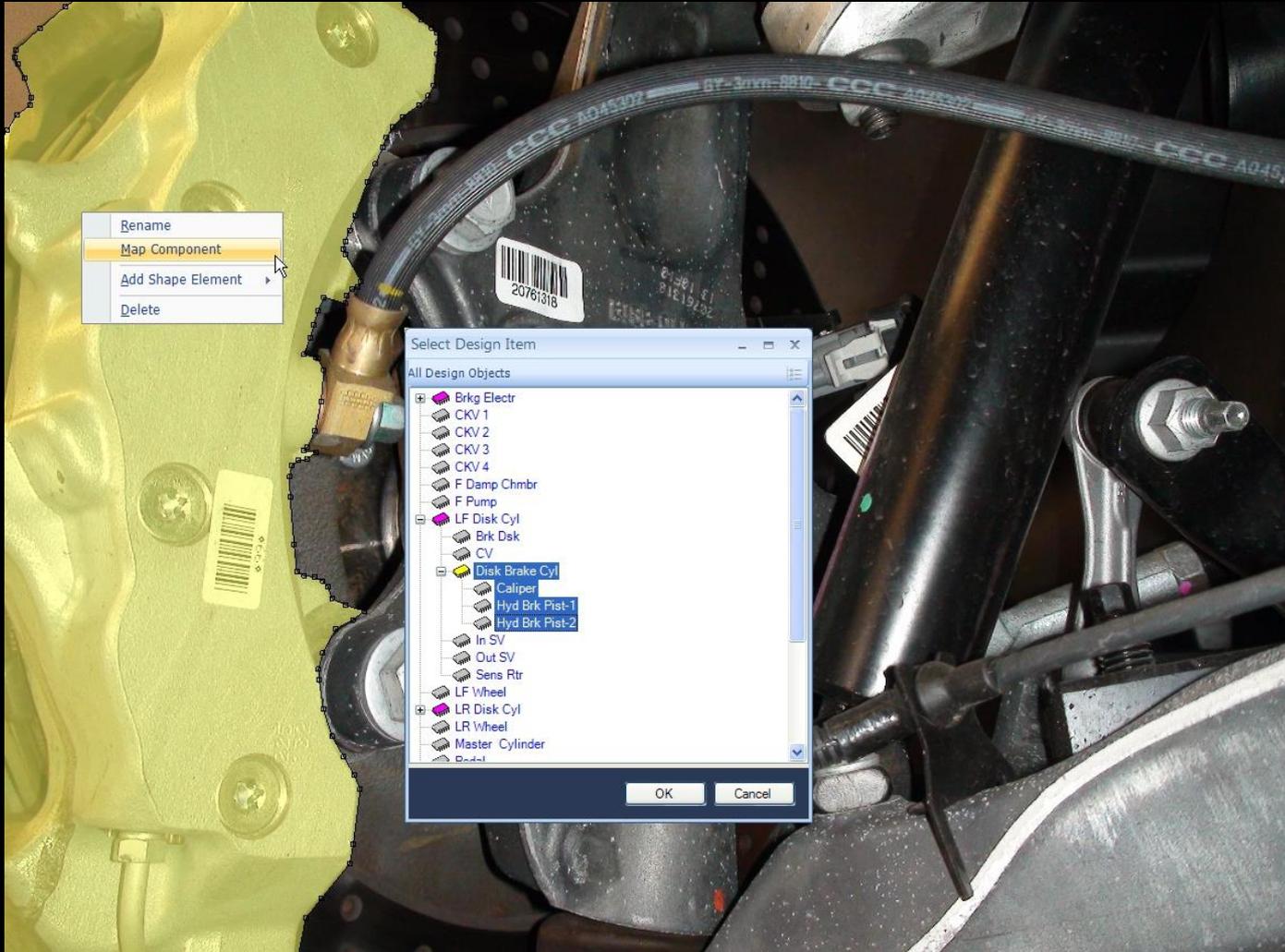
Filename	Page
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# Component Tracing



# Component Mapping



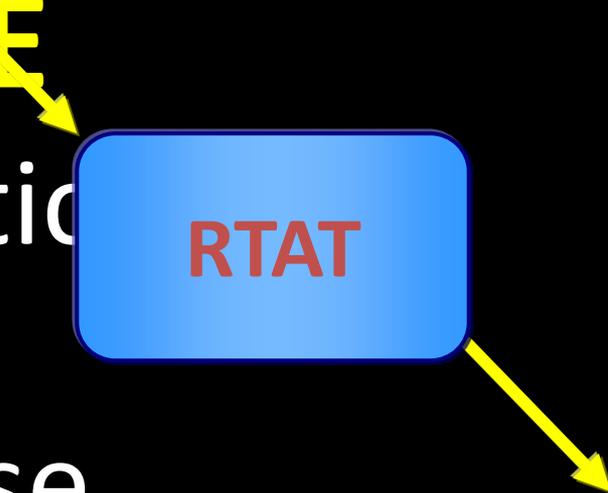
*eXpress*

**SHARE**

Diagnostic  
*and*  
Expertise

**RTAT**

*DSI  
Workbench*



# Health Monitoring

DSI Workbench

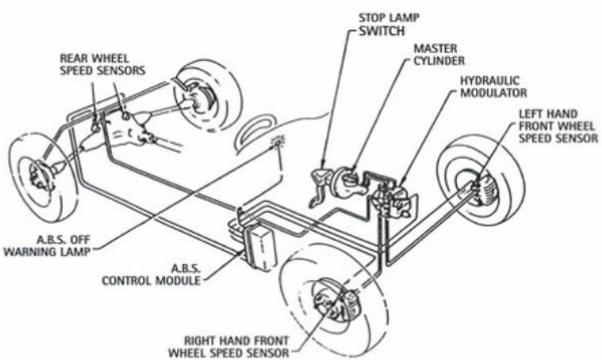
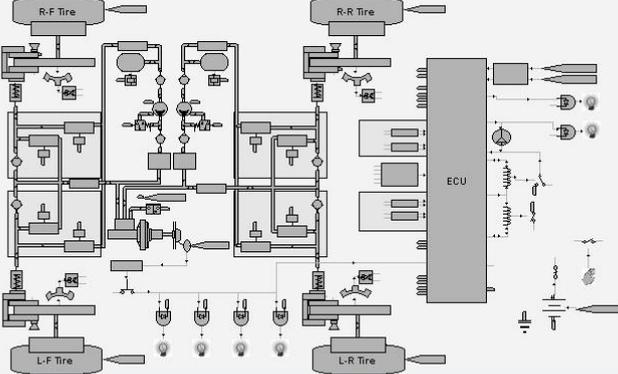
File View Tools Help

Guided Stop Monitor Monitor Control Test Results Panel Layout

Monitoring - No Test Results

Automotive Braking System ... 36%

ABS System (Isometric): Aut... 136%



LF Brake Assy 14%



[Maintenance Manual] 23% Page 5 of 23 Go to page 5

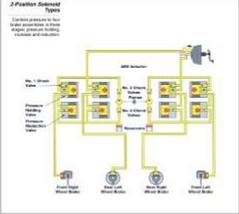
**Types of ABS**

There are four types of ABS systems used to control vehicle stability during the vehicle's operation. The four vehicle types include:

- 2-position solenoid valves
- 3-position solenoid valves with mechanical valve (Bentley)
- 3-position solenoid valves (Oppenheimer)
- 3-position solenoid controlling power steering hydraulic pressure which controls brake hydraulic pressure

**2-Position Solenoid**

2-position solenoid systems use a combination of left and right solenoids. The right solenoid configuration uses two solenoids per brake assembly. The left solenoid configuration uses two solenoids per wheel for rear brake assemblies while the front brake assemblies are controlled independently by two solenoids each.



Microsoft PowerPoint 2010

Diagnostic Status View

# Health Monitoring

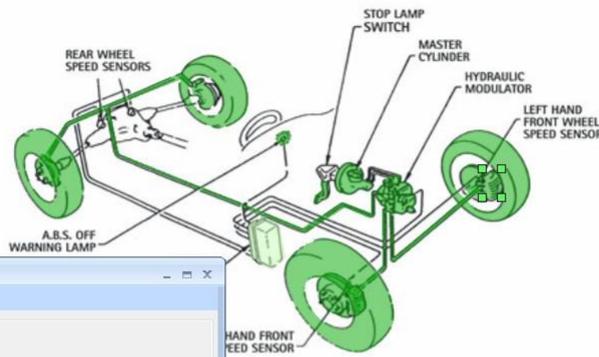
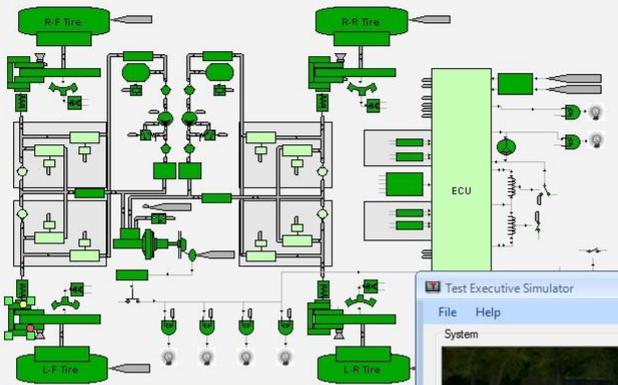
DSI Workbench

File View Tools Help

Guided Stop Monitor Monitor Control Test Results Panel Layout

No Faults Detected - Test Results on 9/7/2012 3:54:22 PM

Automotive Braking System ... ABS System (Isometric): Aut...



Test Executive Simulator

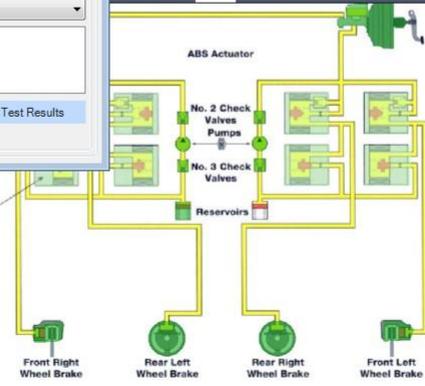
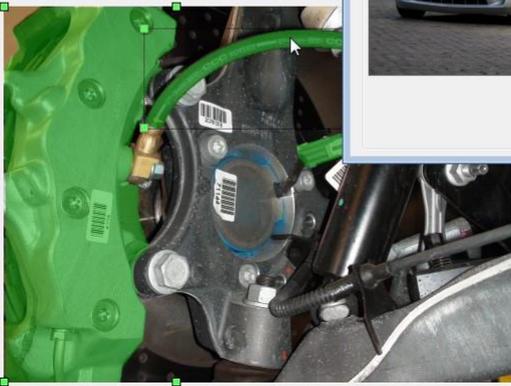
System



System: DSI Automobile  
Version:  
System Diagnostics  
Diagnostics: Anti-Lock Breaking System  
Results Configuration: Test Results

Clear Add Remove Preview Generate Test Results

Results: Test Results Generated on Sep 07, 2012 at 15:54:22



Go to page 5

Diagnostic Status View

# Health Monitoring

DSI Workbench

File View Tools Help

Guided Stop Monitor Monitor Control Test Results Panel Layout

**Fault Detected - Test Results on 9/7/2012 3:55:51 PM**

Primary Suspects

Suspect Item	Repair Cost	Repair Time	Failure Probability
L-Suspect Failure			
Front Pads	\$25.00	2.00	0.067371
LFO Pad			
False Pad squeal			
Pad Squeeling			
pad wear beyond limit			
LF1 Pad			
False Pad squeal			
Pad Squeeling			
pad wear beyond limit			

Automotive Braking System ...

ABS System (Isometric): Aut...

Test Executive Simulator

System

System: DSI Automobile  
Version:  
System Diagnostics: Anti-Lock Breaking System  
Results Configuration: Test Results

LF Squealer Test  
LF Brake Pads - Inspection

Clear Add Remove Preview Generate Test Results

Results: Test Results Generated on Sep 07, 2012 at 15:55:51

Diagnostic Status View

The screenshot displays the DSI Workbench software interface. At the top, a red status bar reads "Fault Detected - Test Results on 9/7/2012 3:55:51 PM". The main workspace is divided into several panels. On the left, a "Primary Suspects" table lists "Front Pads" with a repair cost of \$25.00 and a failure probability of 0.067371. Below this, a "Test Executive Simulator" window is open, showing a car image and test configuration for "Anti-Lock Breaking System". The simulator results indicate "LF Squealer Test" and "LF Brake Pads - Inspection" were performed, with results generated on Sep 07, 2012 at 15:55:51. The background features a 3D schematic of the "Automotive Braking System" and an "ABS System (Isometric)" diagram. The schematic shows the ECU connected to various sensors (R-F Tire, R-R Tire, L-F Tire) and actuators. The ABS diagram labels components like "REAR WHEEL SPEED SENSORS", "STOP LAMP SWITCH", "MASTER CYLINDER", "HYDRAULIC MODULATOR", "LEFT HAND FRONT WHEEL SPEED SENSOR", "FRONT SENSOR", and "A.B.S. OFF WARNING LAMP". A detailed view of the "ABS Actuator" is shown at the bottom right, highlighting "No. 3 Check Valves Pumps", "No. 3 Check Valves", and "Reservoirs".

# Guided Troubleshooting

DSI Workbench Diagnostic Status View

Automotive Braking System SLS

71%

Braking System 15%

Restart Session

Pass Fail

Fault Group # 21  
Replace 1 Item.

Fault Group # 21:  
Replace LF Caliper Assy

Current Isolation Sequence

Test Name	Cost	Time	Result
Test 1-0 Spongy Braking	1	0.016667	Passed
Test 2-0 Hydraulic Leak Test	0	0.016667	Failed
Test 2-1 LR Break Piston - Leak Test	15	0.016667	Passed
Test 2-2 RR Break Piston - Leak Test	5	0.016667	Passed
Test 2-3 RF Break Piston - Leak Test	15	0.016667	Passed
Test 2-4 LF Break Piston - Leak Test	15	0.016667	Failed

Primary Suspects

Suspect Item	Repair Cost	Repair Time	Failure Probab.
LF Caliper Assy	\$73.00	1.50	0.011949
LF Brk Pat			

Hydraulic Leak

R-F Wheel

L-F Wheel

L-R Wheel

RR Brake Lt

RW Brake Lt

LR Brake Lt

Diag Conn

Fluid Low LED

ABS LED

Fluid Low Warning

ABS Warning P-O-T

Coil

Prop Ry Coil

Temp Ry Coil

Brk\_L1V Res

Brk\_L1V Res

100 Ohm Res

Driver Ign In

Battery

Charge

Chassis Gnd

# Guided Troubleshooting

Restart Save and Restart

Fault Group # 76  
Replace Front Pads

Replace Front PADS

Back

Replace Front PADS

Automotive Braking System

ABS System (Isometric): Aut...

[Maintenance Manual]

Primary Suspects

Suspect Item

L Suspect Failure

Front Pads

- LFO Pad
  - False Pad squeal
  - Pad Squeeling
  - pad wear beyond limit
- LFI Pad
  - False Pad squeal
  - Pad Squeeling
  - pad wear beyond limit

how to install corvette brakes.pdf - Adobe Reader

How to Install Corvette Brakes

Install the brakes on a Corvette in a few easy steps.

The Chevrolet Corvette uses composite pads of firm rubber-like brake pad materials. The brake pads are bonded inside of the brake caliper that is mounted over the side of the brake rotor. When the brake pedal is depressed, the caliper pushes the brake pads against the brake rotor, stopping the car. The brake pads are made up of a material that stops the Corvette by applying friction to the side of the brake rotor. The material wears down over time, and you should change the pads before the pad thickness reaches one-eighth of an inch. If you don't, the worn brake pads will damage the brake rotors.

Design View

ISDD Provides...

REALIZED Cost Avoidance

*in*

Development & Sustainment

Added Value at Reduced Cost

# ISDD – Process Improvement Cost Avoidance

Activity	Original Process Description	Process Improvement	Projected Cost Avoidance
Unit Production/ Factory Test	Manual TPS Development, Fault Isolation & Troubleshooting	Conversion of <b>eXpress</b> Diagnostics for Test Executive	Y1: \$300K – <b>\$2.5M</b> Y2: \$600K – <b>\$5.0M</b>
Diagnostic & Engineering Development	Duplication of schematics and functional drawing views	Conversion of <b>eXpress</b> topology in RTAT for 3 <sup>rd</sup> party sharing / viewing	Y1: \$375K – <b>\$1.5M</b> Y2: \$750K – <b>\$3.0M</b>
Diagnostic & Engineering Development	Duplication of processes (e.g. R, M, ILS, Test, Safety)	Using <b>eXpress</b> (via FMECA Plus) as common source database sharing / leveraging	Y1: \$600K – <b>\$1.8M</b> Y2: \$1.2M – <b>\$3.6M</b>
Multiple Variant & Rapid Prototyping	Duplication of diagnostic design for every design variant	Using <b>eXpress</b> to duplicate common diagnostic design	Y1: \$250K – <b>\$1.25M</b> Y2: \$500K – <b>\$2.5M</b>
Operation & Support Data Development	Independent data development for each O&S requirement	Using <b>eXpress</b> & STAGE as common data source for O&S documentation, e.g., IETM, Runtime Reasoner, Training, Test Equipment Requirements, Provisioning, etc.	Y1: \$250K – <b>\$1.25M</b> Y2: \$500K – <b>\$2.5M</b>

**Total Cost Avoidance – Year 1     \$8,300,000**

**Total Cost Avoidance – Year 2     \$16,600,000**

**NEW**

From DSI International

*eXpress*<sup>64</sup>

Better Stronger Faster





DSI International's

**STAGE**



Operational Support  
*and*  
Health Management  
Simulation

# Turnkey Balancing...

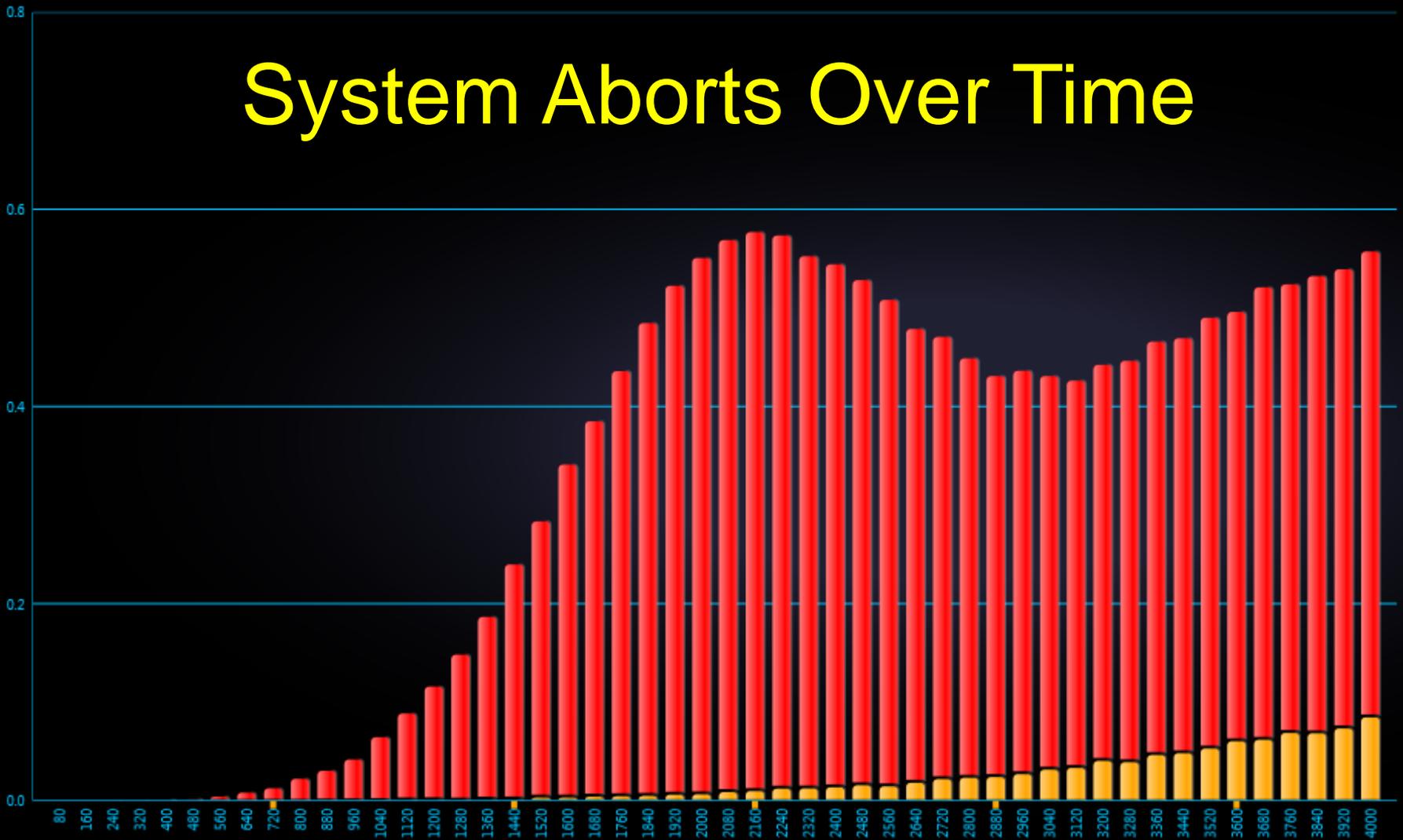
## System Maintenance Strategies

Predictive vs. Run-To-Failure

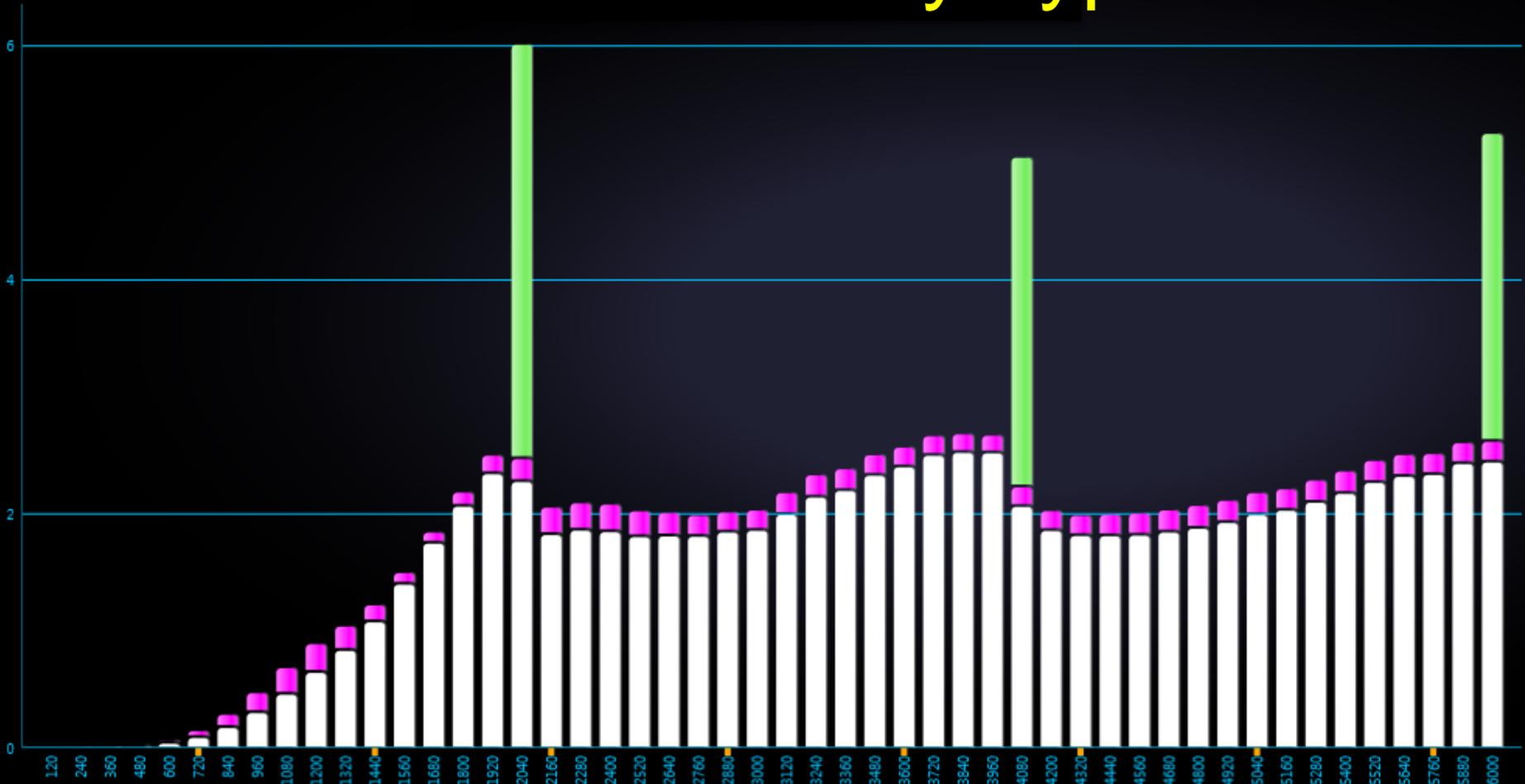
**...in terms of**

**Cost – Safety – Availability  
& Operational Success**

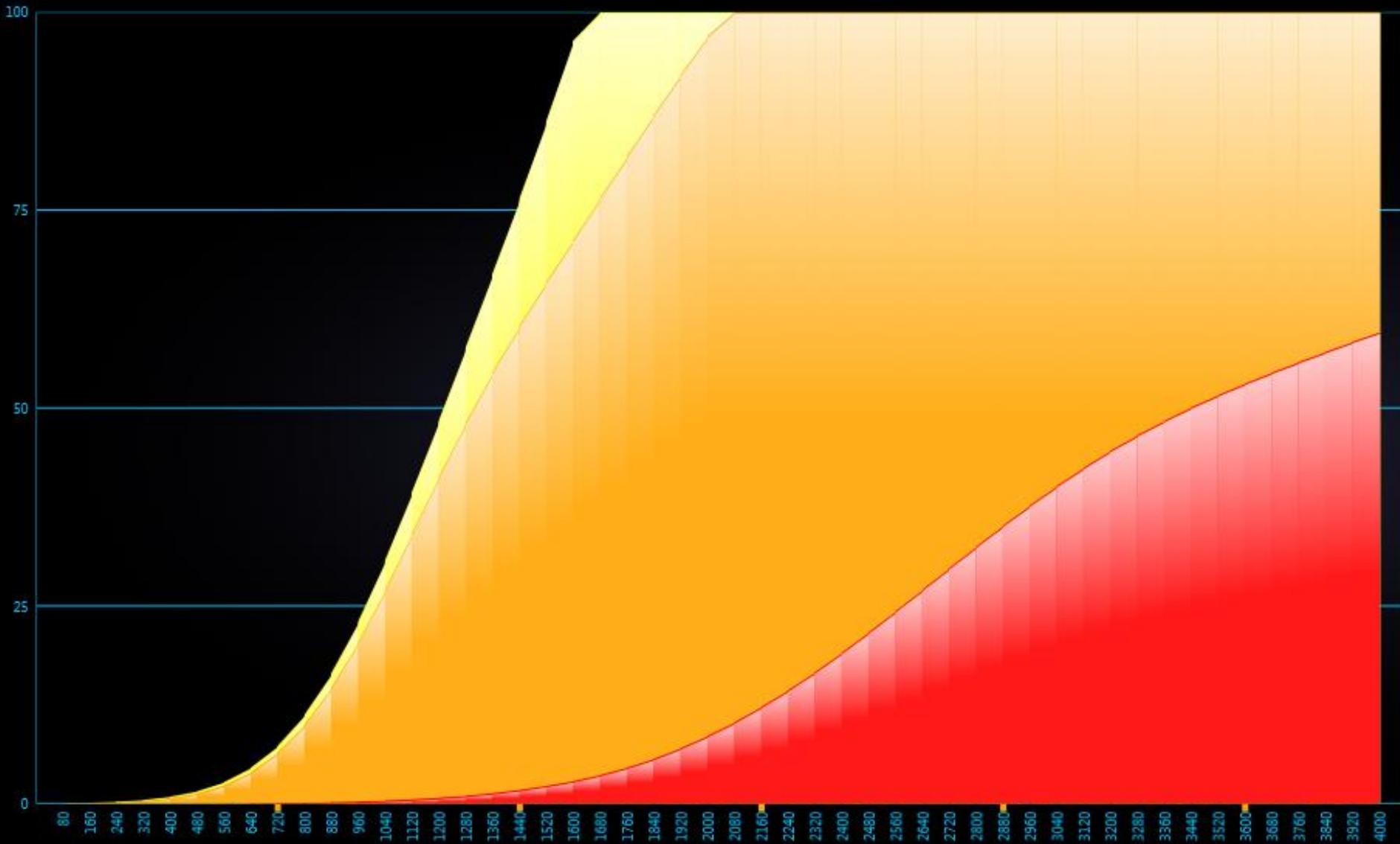
# System Aborts Over Time



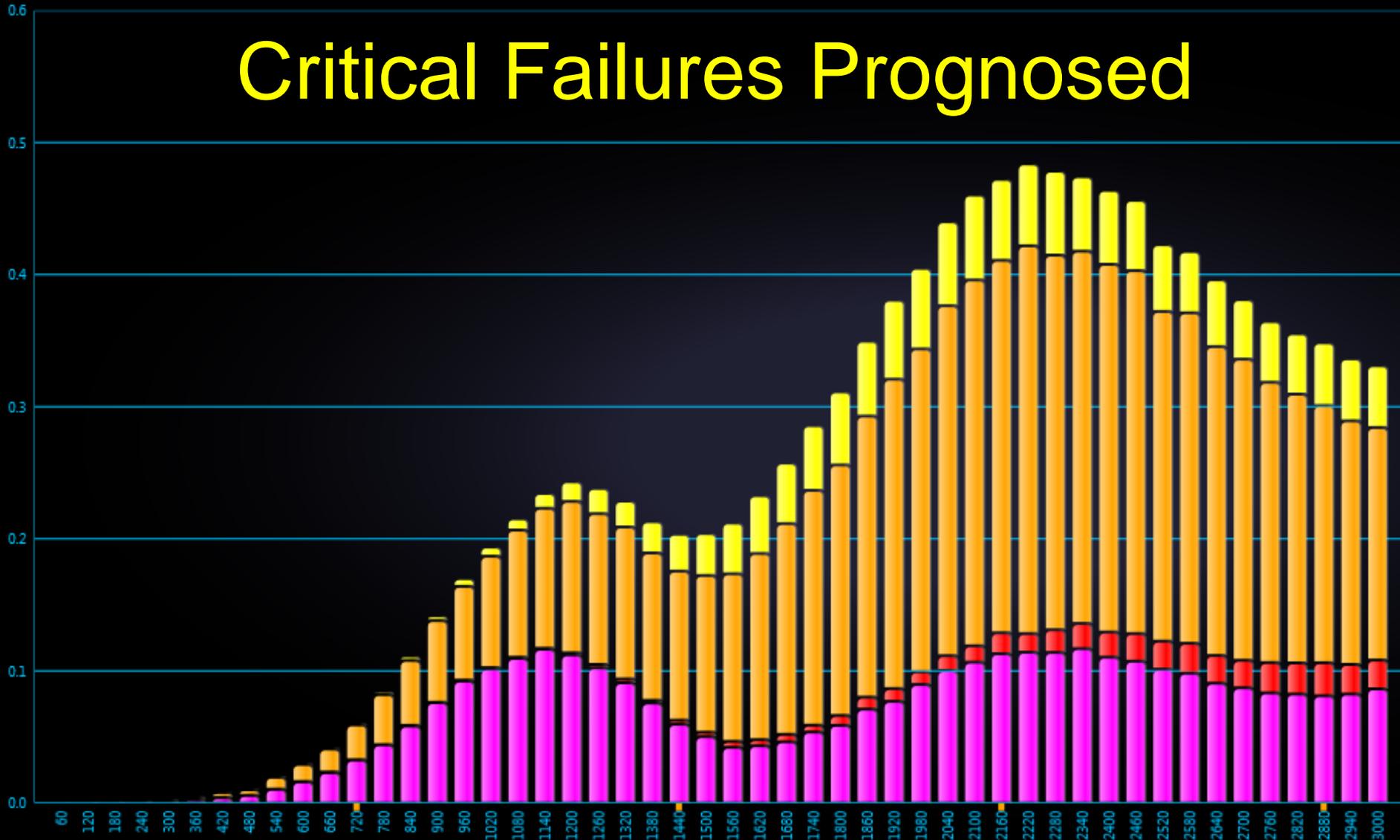
# Maintenance by Type



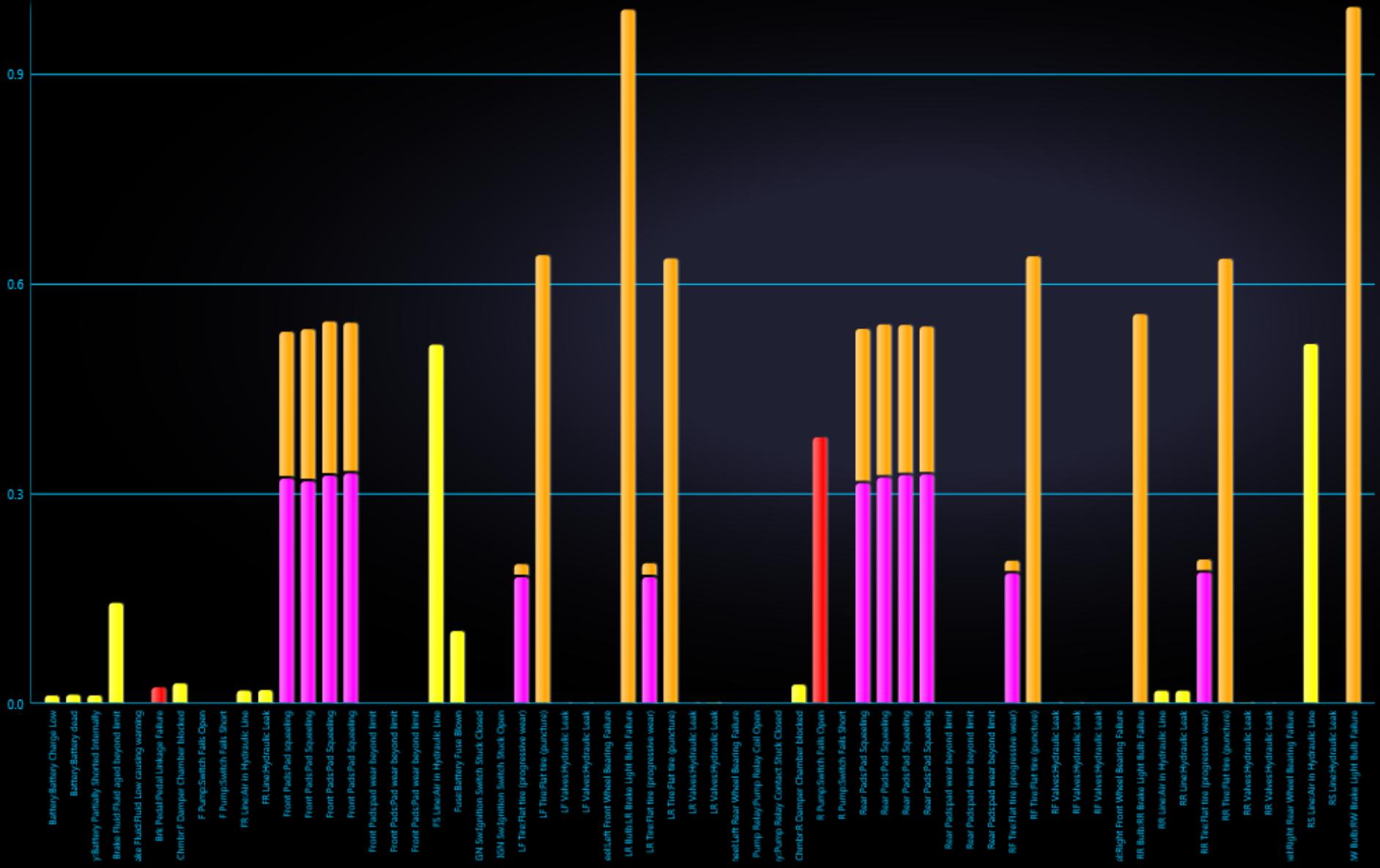
# Likelihood of Critical Failure



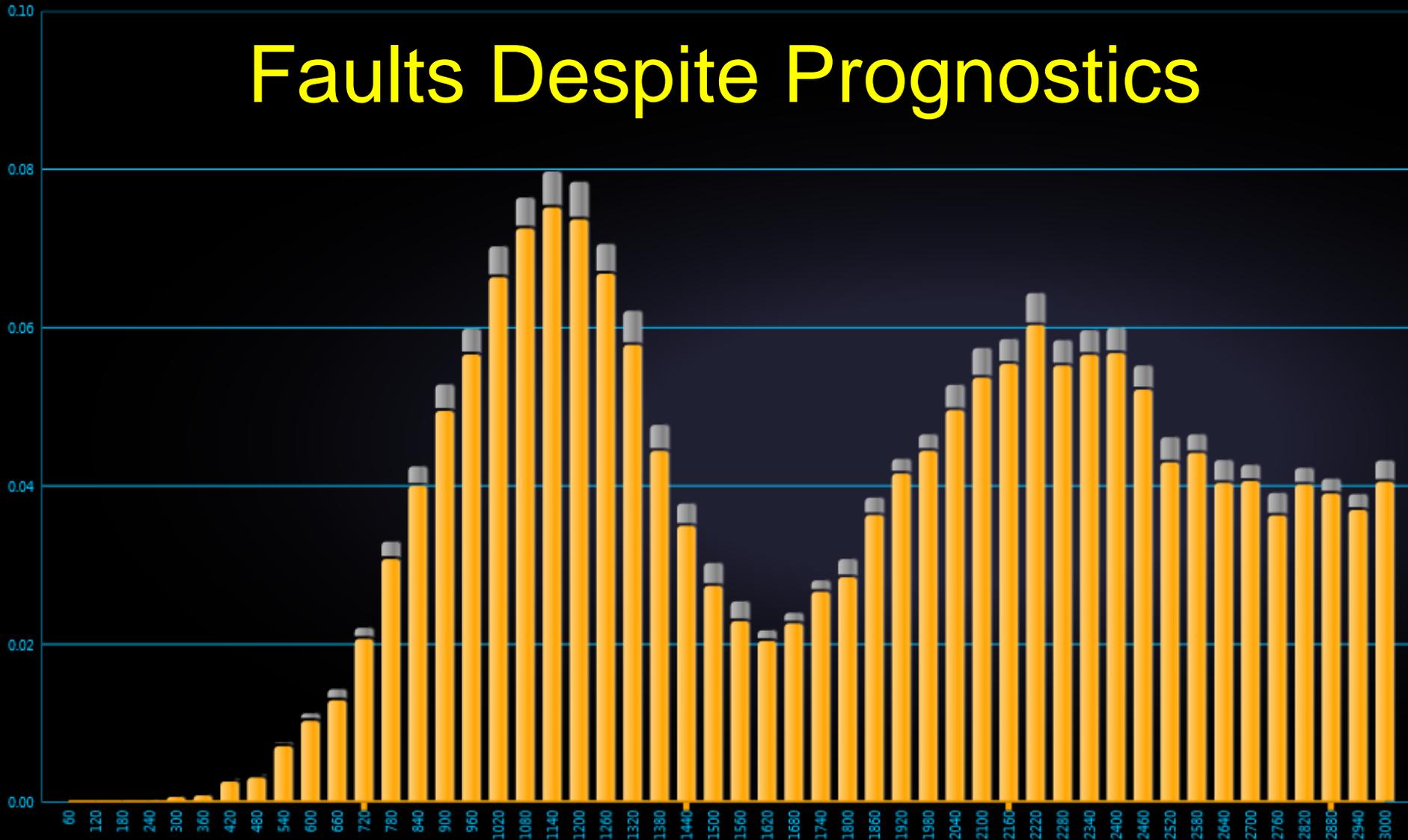
# Critical Failures Prognosed



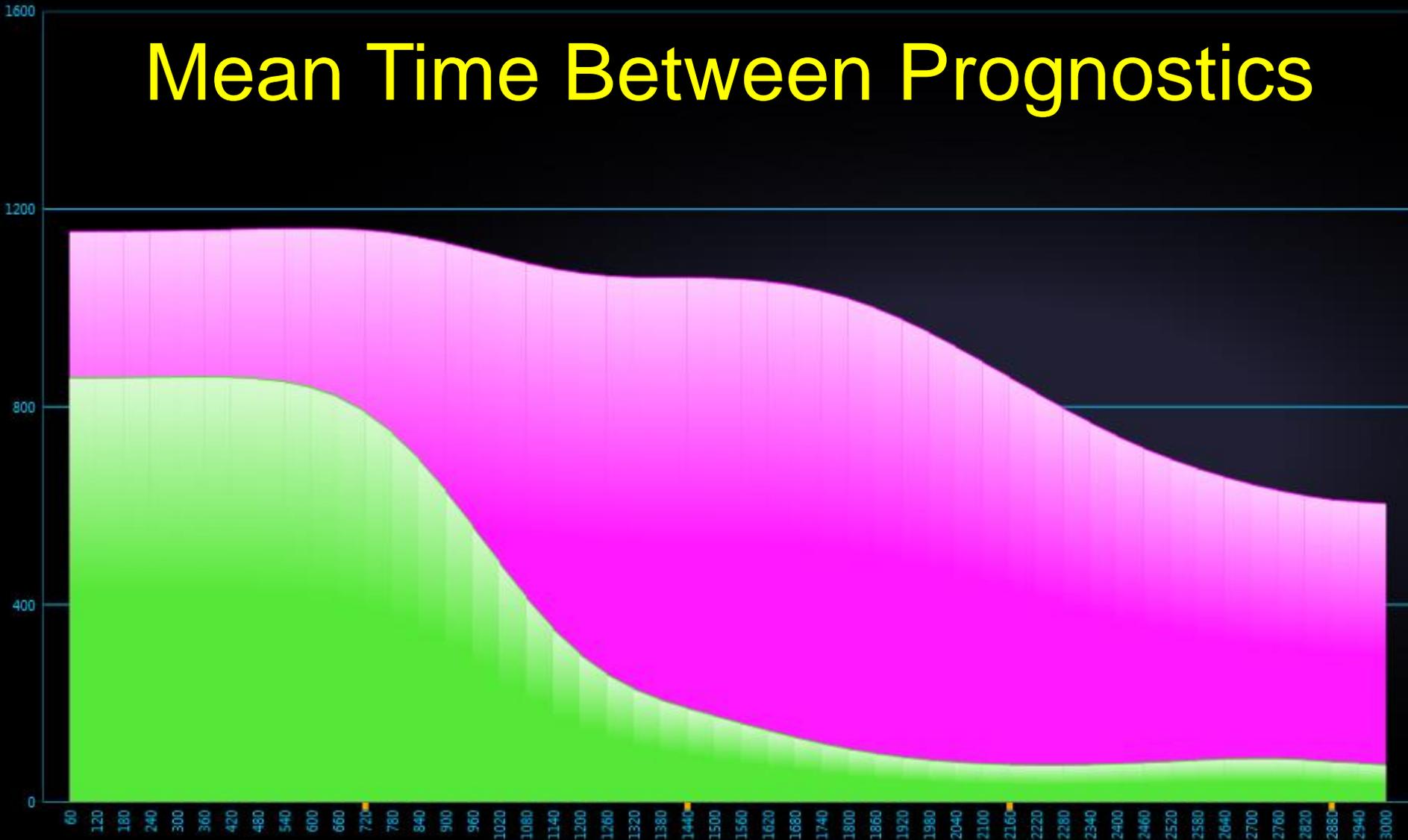
# Critical Failures Prognosed-Identified



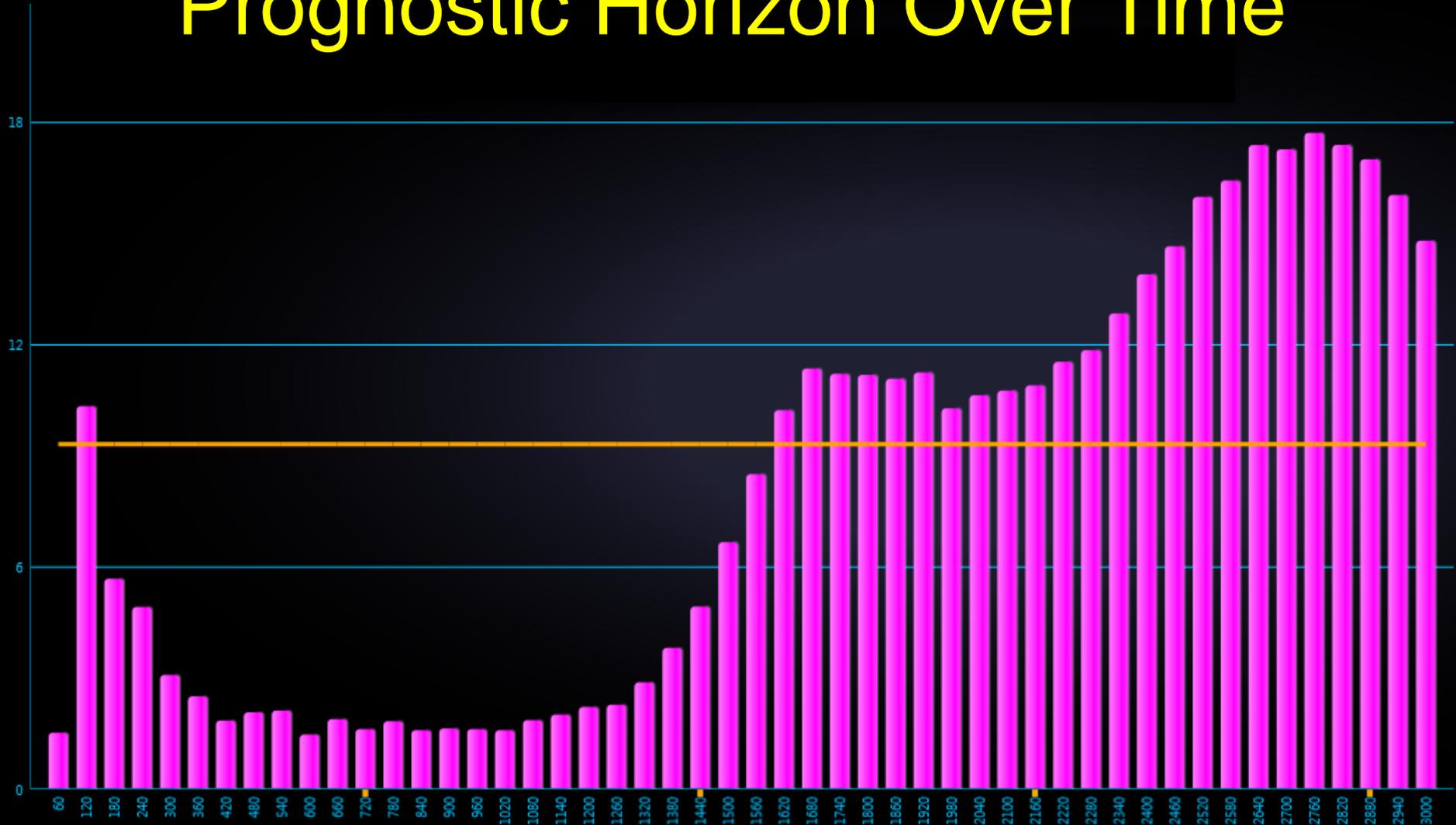
# Faults Despite Prognostics



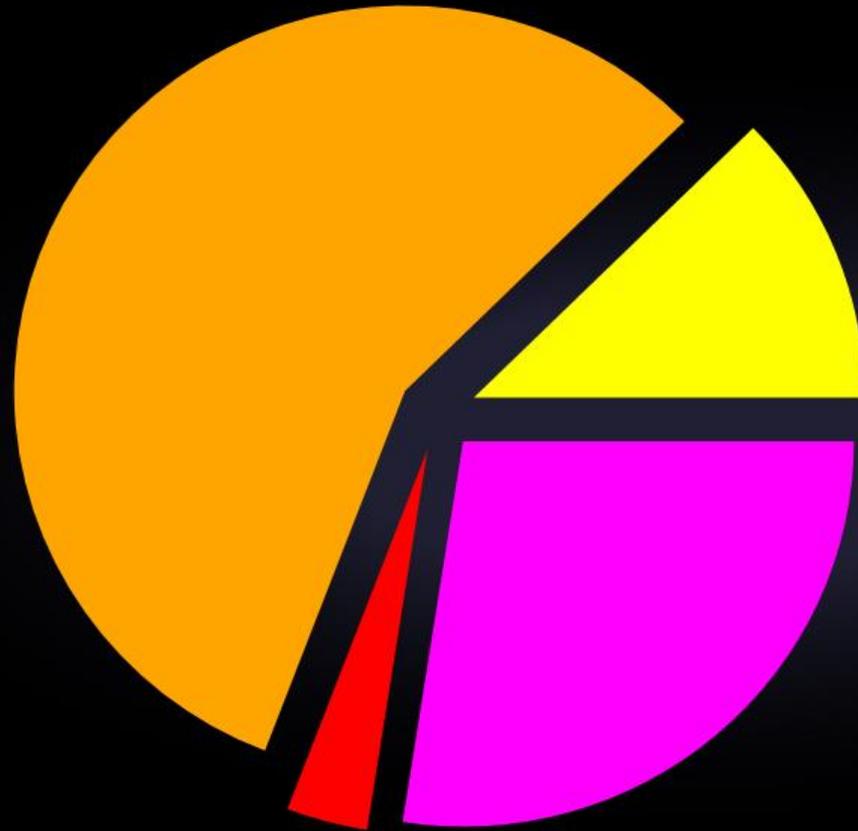
# Mean Time Between Prognostics



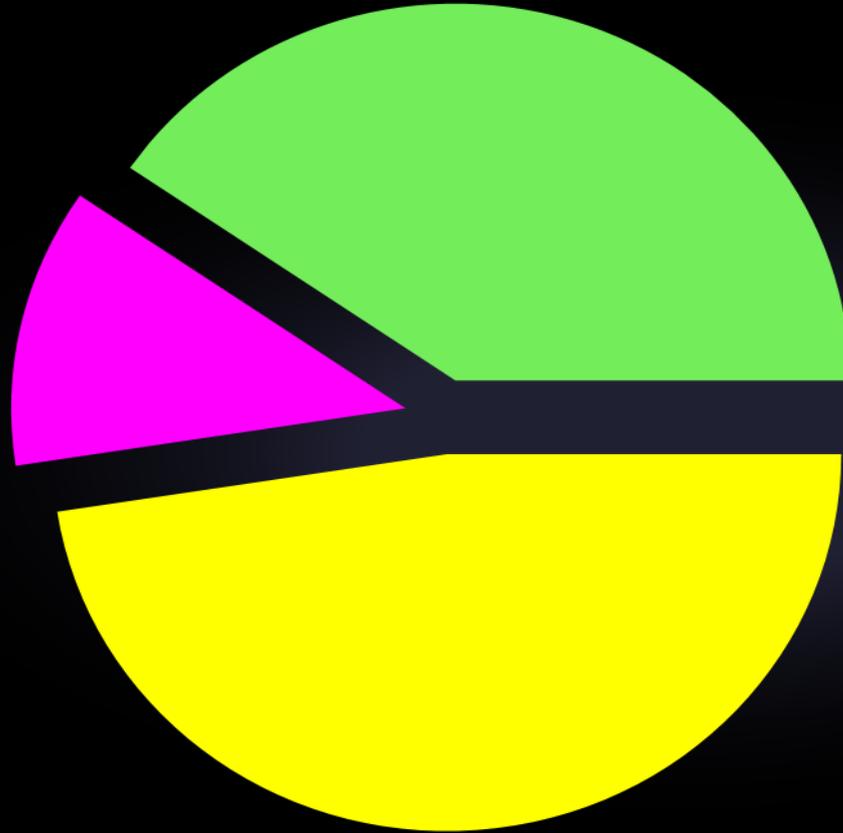
# Prognostic Horizon Over Time



# Critical Failures Prognosed



# Reason for Extra Replacement Cost



# Reason for Replacement Cost per Item

##	Items	Replacement Cost (Item Failure/Wear out)	Replacement Cost (Diagnostic Ambiguity)	Replacement Cost (Prognostics)	Replacement Cost (Scheduled Maintenance)	Totals
1	Master Cyl	52.244	204.057	.000	.000	256.301
2	Brk Pedal	27.322	36.938	.000	.000	64.260
3	FR Line	21.295	26.689	.000	.000	47.984
4	RR Line	21.211	26.618	.000	.000	47.829
5	BL Sw	.334	23.764	.000	.000	24.098
6	BL Sw Adj	.503	23.595	.000	.000	24.098
7	Brake Fluid	18.647	17.340	.000	.000	35.988
8	RS Line	37.478	15.731	.000	10.017	63.227
9	FS Line	37.481	15.716	.000	10.030	63.227
10	ECU	1.065	11.834	.000	.000	12.899
11	GF Sense	1.073	11.664	.000	.000	12.737
12	LF Valves	4.296	2.314	.000	.000	6.610
13	RR Bulb	5.550	.341	.000	.000	5.891
14	Fluid Low LED	.011	.312	.000	.000	.322
15	LR Valves	5.154	.028	.000	.000	5.182
16	F Damp Chmbr	12.627	.016	.000	.000	12.643
17	Pump Relay	.005	.010	.000	.000	.015
18	R Damp Chmbr	12.628	.003	.000	.000	12.631
19	RF Valves	3.504	.000	.000	.000	3.504

# Life-Cycle Performance Metrics

Simulation:	3000 hours (w/o Prev. Maint.)	5000 hours (w/o Prev. Maint.)	8000 hours (w/o Prev. Maint.)
<b>RAM-T Metrics</b>			
Reliability	0.97681	0.96994	0.96584
Mission Length (for Reliability)	2.50 hours	2.50 hours	2.50 hours
Inherent Availability	0.98858	0.98464	0.98144
Operational Availability	0.86473	0.81982	0.78728
Mean Logistics Delay Time (MLDT)	24.00 hours	24.00 hours	24.00 hours
Mean Time to Repair (MTTR)	106.369 minutes	104.042 minutes	103.988 minutes
Mean Time to Replace (MTTR)	75.854 minutes	72.613 minutes	71.774 minutes
Mean Time to Isolate (MTTI)	30.515 minutes	31.428 minutes	32.214 minutes
Fault Detection	96.70%	94.72%	94.26%
Fault Isolation to 1 Item	92.50%	92.30%	92.18%
Fault Isolation to 2 Items or less	92.51%	92.30%	92.19%
Fault Isolation to 3 Items or less	92.51%	92.30%	92.19%
False Alarm Rate (from diagnostics)	0.959%	0.829%	1.035%
<b>Failure Statistics</b>			
Failures	28.358	61.306	111.532
Unique Failures	26.690	43.852	57.350
Total Percentage of Possible Failures	12.187%	20.024%	26.187%
<b>Diagnostic Statistics</b>			
Detected Faults	27.422 (96.699%)	58.070 (94.722%)	105.134 (94.264%)
Non-Detected Faults	0.936 (3.301%)	3.236 (5.278%)	6.398 (5.736%)
Faults Isolated to Fault Group of Size 1	25.366 (92.502%)	53.596 (92.296%)	96.914 (92.181%)
Faults Isolated to Fault Group of Size 2	0.002 (0.007%)	N/A	0.004 (0.004%)
Faults Isolated to Fault Group of Size 4 or Greater	2.054 (7.490%)	4.474 (7.704%)	8.216 (7.815%)
Diagnostic False Alarms	0.272 (0.959%)	0.508 (0.829%)	1.154 (1.035%)
<b>Replacement Statistics</b>			
Removals	35.044	74.700	135.462
True Removals	27.422 (78.250%)	58.070 (77.738%)	105.134 (77.611%)
False Removals	7.622 (21.750%)	16.630 (22.262%)	30.328 (22.389%)

# Maintenance Mix Balancing

Simulation:	Run to Failure	Sched. Maint. (tight)	Sched. Maint. (loose)	Prognostics
<b>Failure Statistics</b>				
Likelihood of Loss of Operation	100% at 1,280 hours	100% at 1,360 hours	100% at 1,680 hours	100% at 1,520 hours
Likelihood of Loss of Equipment	100% at 1,440 hours	100% at 1,760 hours	100% at 2,000 hours	100% at 1,920 hours
Likelihood of Loss of Life	62.098% at 4,000 hours	61.537% at 4,000 hours	62.612% at 4,000 hours	61.904% at 4,000 hours
<b>Prognostic Statistics</b>				
Critical Failures Prognosed	N/A	N/A	N/A	4.787 (27.007%)
Critical Failures Not Prognosed: Loss of Operation	2.780 (15.694%)	2.828 (20.004%)	2.800 (26.677%)	2.787 (15.721%)
Critical Failures Not Prognosed: Loss of Equipment	14.255 (80.486%)	10.622 (75.143%)	7.015 (66.830%)	9.480 (53.484%)
Critical Failures Not Prognosed: Loss of Life	0.677 (3.820%)	0.686 (4.853%)	0.682 (6.493%)	0.672 (3.788%)
<b>Maintenance Statistics</b>				
Corrective Maintenance	54.646 (100.000%)	51.753 (87.637%)	46.943 (72.724%)	50.747 (90.984%)
Scheduled Maintenance	N/A	7.301 (12.363%)	17.607 (27.276%)	N/A
Maintenance due to Prognostics	N/A	N/A	N/A	5.029 (9.016%)
<b>Replacement Statistics</b>				
Replacements due to Item Failure	42.157 (77.146%)	39.143 (66.283%)	34.320 (53.168%)	38.130 (68.362%)
Replacements due to Diagnostic Ambiguity	12.489 (22.854%)	12.611 (21.354%)	12.623 (19.556%)	12.618 (22.622%)
Replacements due to Prognostics	N/A	N/A	N/A	5.029 (9.016%)
Replacements due to Scheduled Maintenance	N/A	7.301 (12.363%)	17.607 (27.276%)	N/A
Remaining Useful Life Per Replacement	1,392.812 hours (3.164%)	1,507.617 hours (5.347%)	1,634.176 hours (9.279%)	1,480.756 hours (6.409%)
Remaining Useful Life Per Early Replacement	2,222.812 hours (4.791%)	2,322.021 hours (7.652%)	2,418.948 hours (12.072%)	2,287.480 hours (9.290%)
<b>Cost-Related Statistics</b>				
Wasted Item Cost	274.53	680.85	1,162.97	392.29
Wasted Item Cost due to False Removals	274.53 (100.000%)	279.49 (41.050%)	276.79 (23.800%)	279.03 (71.130%)
Wasted Item Cost due to Prognostics	N/A	N/A	N/A	113.25 (28.870%)
Wasted Item Cost due to Scheduled Maintenance	N/A	401.36 (58.950%)	886.18 (76.200%)	N/A
Cost of Extra Replacements	105.24	399.31	694.67	133.24
Cost of Extra Replacements due to False Removals	105.24 (100.000%)	109.74 (27.483%)	105.26 (15.152%)	110.55 (82.965%)
Cost of Extra Replacements due to Prognostics	N/A	N/A	N/A	22.70 (17.035%)
Cost of Extra Replacements due to Scheduled Maintenance	N/A	289.57 (72.517%)	589.41 (84.848%)	N/A