# **Non-Functional Testing**

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## **📖 Introduction**

Non-Functional Testing (NFT) evaluates how a system performs under various conditions, focusing on:  
✔ Speed (Performance)  
✔ Stability (Load/Stress)  
✔ Security (Vulnerabilities)  
✔ User Experience (Usability)  
✔ Compatibility (Devices/OS)  
✔ Durability (Reliability)

Unlike Functional Testing (which checks what the system does), NFT ensures how well it does it.

## **⚡ Performance Testing**

### **What is it?**

Measures speed, responsiveness, and stability under expected workloads.

### **Key Metrics**

* Response Time (e.g., API latency)
* Throughput (Requests/sec)
* Resource Usage (CPU, Memory)

### **Tools**

* JMeter
* Gatling
* LoadRunner

### **Example**

* Test: Measure login response time for 100 concurrent users.
* Goal: Ensure <2 sec response under peak load.

## **🏋️ Load Testing**

### **What is it?**

Tests system behavior under expected user loads.

### **Key Aspects**

* Identifies bottlenecks (DB, network).
* Validates scalability.

### **Tools**

* JMeter
* k6

### **Example**

* Scenario: Simulate 10,000 users browsing an e-commerce site.
* Pass Criteria: No errors, <3 sec page load.

## **💥 Stress Testing**

### **What is it?**

Pushes system beyond normal limits to find breaking points.

### **Key Goals**

* Determine max capacity.
* Check graceful degradation.

### **Tools**

* Locust
* BlazeMeter

### **Example**

* Test: Spike traffic to 50,000 users (200% of normal).
* Outcome: System slows but doesn’t crash.

## **⏳ Endurance Testing (Soak Testing)**

### **What is it?**

Tests system under sustained load (hours/days) to find memory leaks or failures.

### **Key Metrics**

* Memory usage over time.
* DB connection leaks.

### **Tools**

* JMeter (long-running tests)
* Prometheus (monitoring)

### **Example**

* Test: Run checkout process continuously for 72 hours.
* Outcome: No performance degradation.

## **🔒 Security Testing**

### **What is it?**

Identifies vulnerabilities (hacks, data breaches).

### **Types**

* Penetration Testing (Ethical hacking)
* SAST/DAST (Static/Dynamic Analysis)

### **Tools**

* OWASP ZAP
* Burp Suite

### **Example**

* Test: SQL injection on login form.
* Fix: Parameterized queries.

## **🖱️ Usability Testing**

### **What is it?**

Evaluates user-friendliness (UI/UX).

### **Methods**

* A/B Testing
* User Surveys

### **Example**

* Task: "Find and purchase a product."
* Metric: Success rate (>90%).

## **📱 Compatibility Testing**

### **What is it?**

Checks performance across devices, OS, browsers.

### **Tools**

* BrowserStack
* Sauce Labs

### **Example**

* Test: Login on iOS 15 + Android 12 + Chrome/Firefox.

## **🛡️ Reliability Testing**

### **What is it?**

Ensures system operates without failure over time.

### **Metrics**

* MTBF (Mean Time Between Failures)
* Recovery time after crashes.

### **Example**

* Test: Auto-retry failed transactions.

## **🆚 Comparison Summary**

| **Type** | **Purpose** | **Key Metric** |
| --- | --- | --- |
| Performance | Speed under load | Response time |
| Load | Expected traffic | Throughput |
| Stress | Breaking point | Max capacity |
| Endurance | Long-term stability | Memory leaks |
| Security | Vulnerability checks | OWASP Top 10 |
| Usability | UX quality | Task success rate |
| Compatibility | Cross-platform work | Device/OS coverage |
| Reliability | Failure resistance | MTBF |

## **🏆 Best Practices**

✔ Automate performance/load tests (CI/CD).  
✔ Prioritize critical user journeys.  
✔ Combine NFT with functional testing.

## **🌍 Real-World Examples**

* Twitter Fail Whale: Insufficient load testing for traffic spikes.
* Equifax Breach: Missing security testing for Apache Struts.

## **📚 References**

* [ISTQB Non-Functional Testing](https://www.istqb.org/)
* [Google Performance Guides](https://web.dev/performance/)

🔹 Conclusion:  
NFT ensures your system is fast, secure, and reliable. Ignore it at your peril!

