Frontend Design Specification

GRP Pipe Ring Stiffness Test Machine

Web-Based Control Interface

1. Project Overview

This document describes the frontend requirements for a web-based control interface for an industrial GRP (Glass Reinforced Plastic) pipe testing machine. The system tests pipe ring stiffness according to ISO 9969 international standard.

1.1 Application Purpose

- Control servo motor movement (up/down positioning)
- Display real-time force and position measurements
- Run automated ring stiffness tests
- Calculate and display results per ISO 9969
- Generate PDF reports and export data to Excel

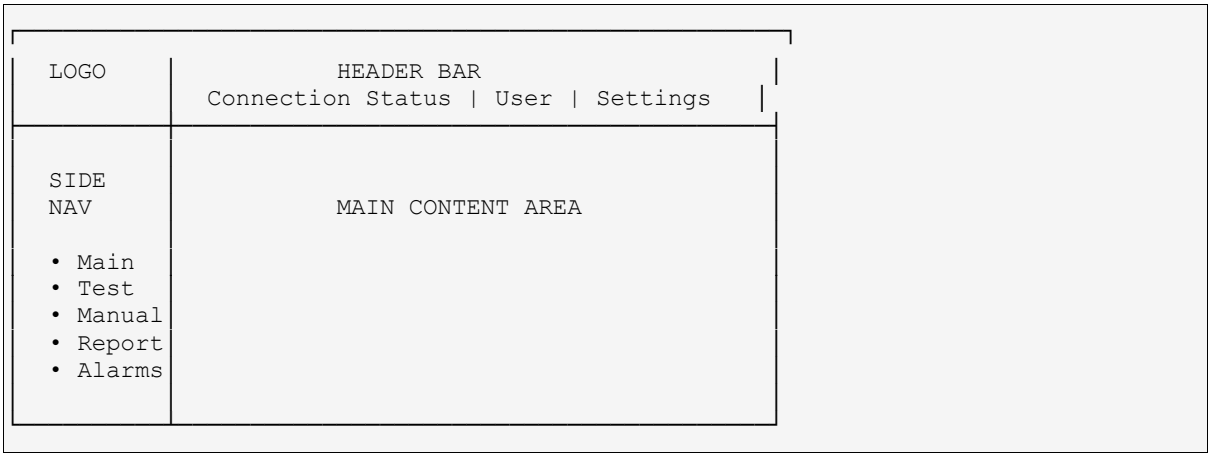
1.2 Technical Stack (Recommended)

Component	Recommendation
Framework	React.js or Vue.js
UI Library	Tailwind CSS + shadcn/ui or Vuetify
Charts	Chart.js or Plotly.js (for real-time graphs)
Real-time	WebSocket (Socket.IO client)
Icons	Lucide Icons or Font Awesome
Language	Arabic (RTL) + English support

2. Application Structure

2.1 Navigation Layout

Single Page Application (SPA) with sidebar navigation:



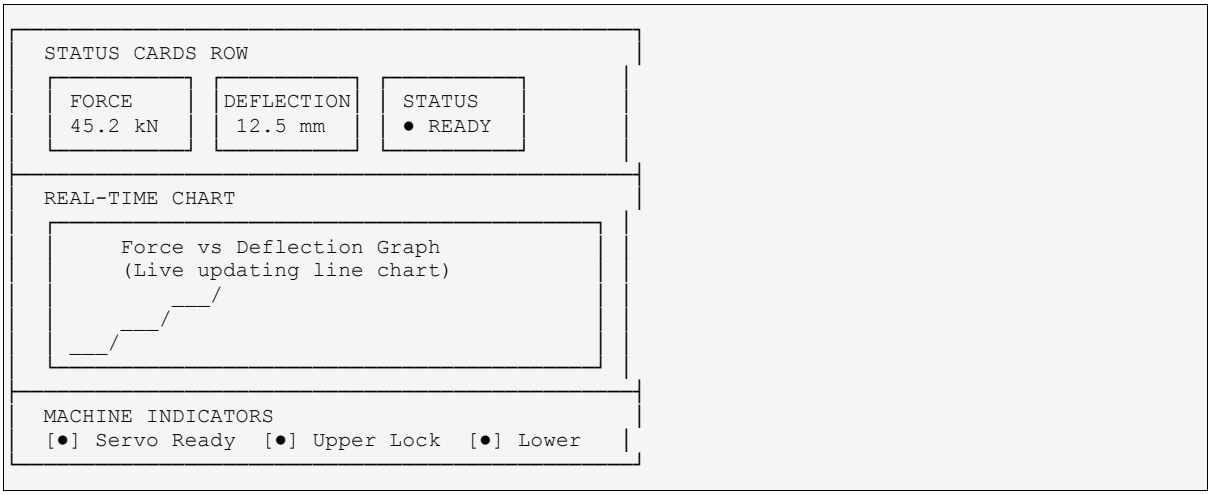
2.2 Pages Overview

#	Page Name	Purpose
1	Dashboard	Main screen - live data display, quick status
2	Test Setup	Configure test parameters, start automated test
3	Manual Control	Manual jog, enable/disable, clamp control
4	Results & Reports	Test history, PDF generation, Excel export
5	Alarms	Active/historical alarms, acknowledge
6	Settings	System configuration, calibration

3. Page 1: Dashboard (الرئيسية)

The main screen showing real-time machine status and measurements.

3.1 Layout Wireframe



3.2 Components Detail

3.2.1 Status Cards

Card	Data Source	Format	Update Rate
Force	actual_force	XX.XX kN (2 decimals)	100ms
Deflection	actual_deflection	XX.XX mm (2 decimals)	100ms
Position	actual_position	XX.XX mm (2 decimals)	100ms
Status	test_status	Text + Color indicator	500ms

3.2.2 Status Values

Code	Text (English)	Text (Arabic)	Color
0	IDLE	جاهز	Gray #6B7280
1	STARTING	بدء التشغيل	Blue #3B82F6
2	TESTING	جاري الاختبار	Yellow #F59E0B
3	AT TARGET	وصل الهدف	Green #10B981
4	RETURNING	العودة	Blue #3B82F6
5	COMPLETE	اكتمل	Green #10B981
-1	ERROR	خطأ	Red #EF4444

3.2.3 Real-Time Chart

- **Type:** Line chart (XY scatter with line)
- **X-Axis:** Deflection (mm) - range 0 to Target + 10%
- **Y-Axis:** Force (kN) - auto-scale
- **Update:** Add new point every 100ms during test
- **Features:** Vertical line at target deflection (3%)
- **Clear:** Reset chart when new test starts

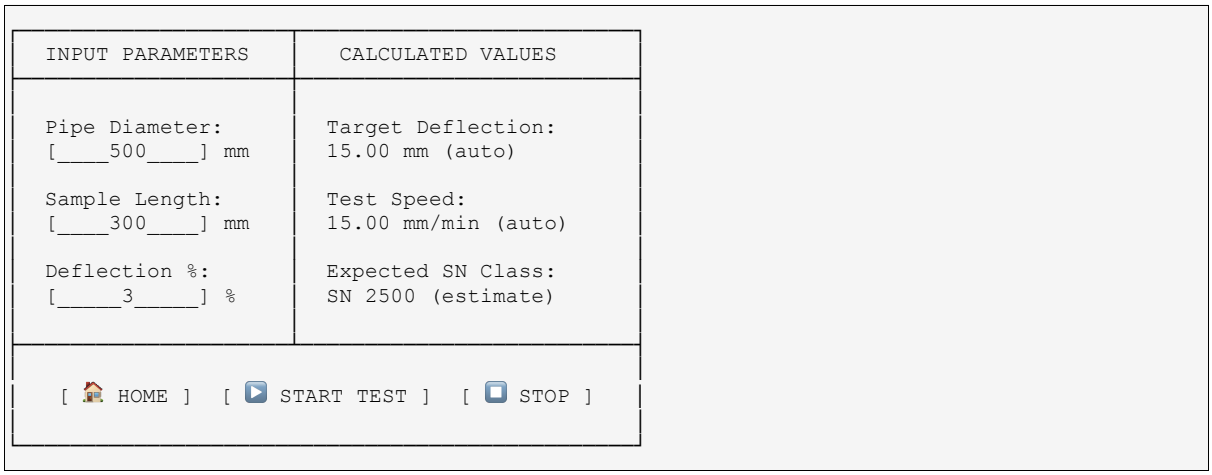
3.2.4 Machine Indicators

Indicator	Data Source	ON Color	OFF Color
Servo Ready	servo_ready	Green	Gray
Servo Error	servo_error	Red (blinking)	Gray
Upper Lock	lock_upper	Green	Gray
Lower Lock	lock_lower	Green	Gray
At Home	at_home	Blue	Gray

4. Page 2: Test Setup (إعداد الاختبار)

Configure test parameters and start automated testing.

4.1 Layout Wireframe



4.2 Input Fields

Field	Type	Default	Range	Validation
Pipe Diameter	Number	500	50 - 3000 mm	Required, positive
Sample Length	Number	300	100 - 1000 mm	Required, positive
Deflection %	Number	3	1 - 10 %	Required, positive
Operator Name	Text	-	Max 50 chars	Optional
Sample ID	Text	Auto	Max 20 chars	Auto-generate

4.3 Calculated Fields (Read-Only)

Field	Formula
Target Deflection	= Pipe_Diameter × (Deflection_% / 100)
Test Speed	= 12 mm/min if Diameter ≤ 710, else 0.03 × Diameter

4.4 Action Buttons

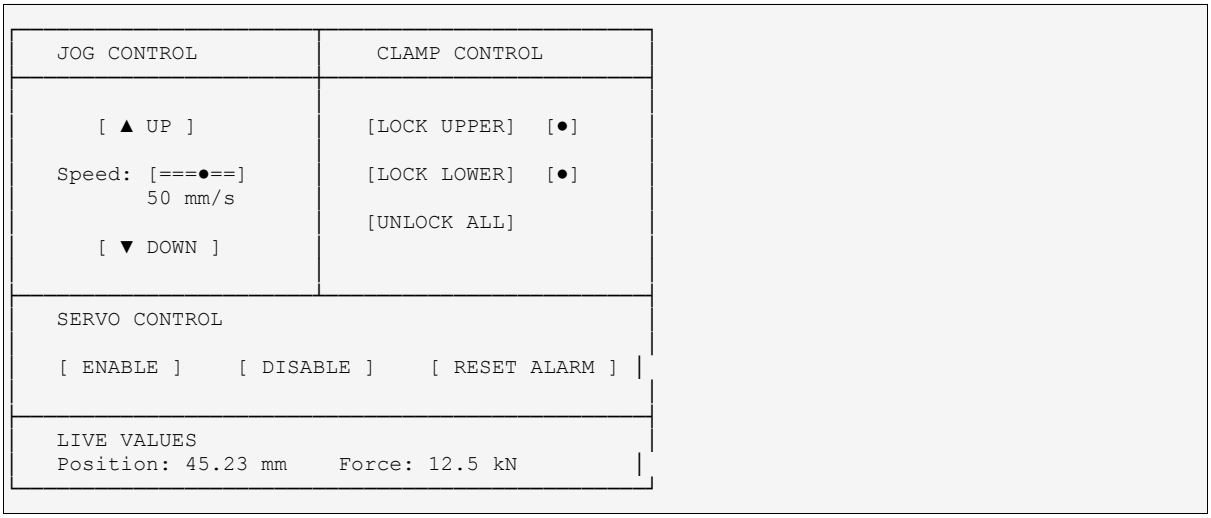
Button	Icon	Action	API Endpoint
HOME	🏠	Move to home position	POST /api/command/home
START TEST	▶️	Begin automated test	POST /api/test/start
STOP	⏹️	Emergency stop	POST /api/command/stop

⚠️ **UX Note:** START button should be disabled if: servo not ready, servo error, test already running, or no parameters entered. Show tooltip explaining why.

5. Page 3: Manual Control (التحكم اليدوي)

Direct machine control for setup and maintenance.

5.1 Layout Wireframe



5.2 Jog Control Section

Element	Type	Behavior	API
JOG UP	Hold Button	Move while pressed	WS: jog_backward
JOG DOWN	Hold Button	Move while pressed	WS: jog_forward
Speed Slider	Range Slider	1-100 mm/s	POST /api/jog/speed

🔴 **CRITICAL:** JOG buttons must send FALSE immediately on mouseup/touchend. Use WebSocket for instant response. If connection lost, default to STOP.

5.3 Clamp Control Section

Button	API	Description
LOCK UPPER	POST /api/clamp/upper/lock	Lock upper clamp + show indicator
LOCK LOWER	POST /api/clamp/lower/lock	Lock lower clamp + show indicator
UNLOCK ALL	POST /api/clamp/unlock	Release both clamps

5.4 Servo Control Section

Button	API	Description
ENABLE	POST /api/servo/enable	Enable servo motor (MC_Power ON)
DISABLE	POST /api/servo/disable	Disable servo motor
RESET ALARM	POST /api/servo/reset	Clear servo fault

6. Page 4: Results & Reports (النتائج والتقارير)

6.1 Current Test Results Section

Field	Format	Example
Force at 3%	XX.XX kN	45.23 kN
Ring Stiffness	XX.XX kN/m²	5.67 kN/m²
SN Class	SN XXXX	SN 5000
Test Result	PASS / FAIL	✅ PASS

6.2 Test History Table

Paginated table with sorting and filtering:

Date/Time	Sample ID	Diameter	Stiffness	Result	Actions
2026-01-01	GRP-001	500 mm	5.67	✅ PASS	[PDF] [View]

6.3 Export Buttons

Button	Action	API Endpoint
PDF Report	Download single test PDF	GET /api/report/pdf/{id}
Excel Export	Export filtered data to Excel	GET /api/report/excel
Chart Image	Download Force/Deflection chart	GET /api/report/chart/{id}

6.4 PDF Report Content

1. Company Logo & Header
2. Test Information (Date, Operator, Sample ID)
3. Test Parameters (Diameter, Length, Deflection %)
4. Results (Force, Stiffness, SN Class, PASS/FAIL)
5. Force vs Deflection Graph
6. ISO 9969 Compliance Statement
7. Digital Signature Area

7. Page 5: Alarms (الإنذارات)

7.1 Active Alarms Section

Display currently active alarms with blinking indicator:

Time	Alarm	Action
10:45:23	🔴 Servo Fault - Overcurrent	[ACKNOWLEDGE]

7.2 Alarm Codes

Code	Description	Arabic	Severity
1	Servo Fault	خطأ السيرفو	🔴 Critical
2	Emergency Stop	إيقاف طوارئ	🔴 Critical
3	Overload	حمل زائد	🔴 Critical
4	Position Limit	حد الموقع	🟡 Warning
5	Communication Lost	فقد الاتصال	🟡 Warning

7.3 Alarm History

Filterable log of all past alarms with date range picker.

8. Page 6: Settings (الإعدادات)

8.1 Sections

Section	Contents
Connection	PLC IP Address, Port, Connection Status, Reconnect Button
Calibration	Load Cell Zero, Load Cell Span, Position Zero
Limits	Max Force, Max Stroke, Speed Limits
Language	Arabic / English toggle
About	Version, License, Support Contact

9. Global Components

9.1 Header Bar

- **Logo:** Company logo (left side)
- **Connection Status:** 🟢 Connected / 🔴 Disconnected (with tooltip showing IP)
- **Emergency Stop:** Big red button always visible
- **Language Toggle:** AR / EN switch

9.2 Sidebar Navigation

Icon	Label	Route
📊	Dashboard	/
⚙️	Test Setup	/test
🎮	Manual	/manual
📋	Reports	/reports
⚠️	Alarms	/alarms
🔧	Settings	/settings

9.3 Toast Notifications

Type	Color	Duration
Success	Green #10B981	3 seconds
Error	Red #EF4444	5 seconds
Warning	Yellow #F59E0B	4 seconds
Info	Blue #3B82F6	3 seconds

10. Design Guidelines

10.1 Color Palette

Name	Hex	Usage
Primary	#1F4E79	Headers, primary buttons
Success	#10B981	PASS, Ready, OK states
Danger	#EF4444	STOP, Error, FAIL states
Warning	#F59E0B	Caution, In Progress
Info	#3B82F6	Information, links
Background	#F3F4F6	Page background
Card BG	#FFFFFF	Cards, modals

10.2 Typography

- **English Font:** Inter or Roboto
- **Arabic Font:** Cairo or IBM Plex Arabic
- **Monospace:** JetBrains Mono (for values)

10.3 Responsive Breakpoints

Name	Width	Layout
Desktop	≥ 1280px	Full sidebar + content
Tablet	768px - 1279px	Collapsible sidebar
Mobile	< 768px	Bottom navigation

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