

Traceability

3 Examples

Example 1

Midterm Presentation

Traceability

Customer Need	Requirement	Test Case	Test Results	Comments
Height Adjustment and Weight Release	Weight of up to 1kg can be picked up to desired height and released by a switch		Pass	System can lift 1kg weight 0-2m and hold weight for 30 min.
Recoil Arrest System	Impact weight is prevented from bouncing back on the specimen via arrest magnet		Fail	Magnet is not strong enough to stop moving weight. A different magnet/more magnets required
Velocity Measurement	System measures the final velocity of the moving weight.		Pass	System can accurately and reliably measure velocity.
Tower Physical Dimensions	Tower needs to be able to release weight from height of 2m		Pass	Tower is able to drop a weight from a height of 2m.
Impact Force Measurement	System to measure the force of impact of the weight on specimen	N/A	N/A	Using a pressure sensitive film from a third party.

Example 1

Final Presentation

Traceability & Tests Results

Customer Need	Requirement	Test Case	Test Results	Comments
Height Adjustment and Weight Release	Weight of up to 1kg can be picked up to desired height and released by the string that is attached to the weight	020	Pass	System can lift 1kg weight 0-2m and hold weight for 30 min.
Recoil Arrest System	Impact weight is prevented from bouncing back on the specimen via arrest magnet	030	Pass	System Arrests the impact weight from all relevant heights along the drop tube.
Velocity Measurement	System measures the final velocity of the moving weight.	040	Pass	System can accurately and reliably measure velocity.
Tower Physical Dimensions	Tower needs to be able to release weight from height of 2m	010	Pass	Tower is able to drop a weight from a height of 2m.
Impact Force Measurement	System to measure the force of impact of the weight on specimen	N/A	N/A	Using a pressure sensitive film from a third party.

Example 2

Midterm Presentation

Traceability

Customer Need	Requirements	Tests	Test Result	Comments
Biocompatible and sterilizable / autoclavable	Components in contact with cells made of autoclavable resin	N/A	N/A	Tested by Dr. Grasman's previous team
Fit in 12 well-plate	Components printed and laser cut to fit in standard 12 well-plate	Test 010 - Dimensions	TBD	
Ability to survive in incubator	Airtight encasement for stepper motor and electronics	Test 015 - Sealability	TBD	
User friendly	Rotary switch to select desired strain & LEDs to show which strain is being run	Test 030 - Entire system test	TBD	
Ability to mechanically actuate	Interaction of all moving parts at maximum strain rate in order to ensure accuracy and effectiveness	Test 021 - Interaction of Actuator, Moving Arm, and Railing	TBD	
Ability to produce 5-15% strain	Stepper motor programmed to rotate X steps depending on selected strain %	Test 031 - Strain accuracy	TBD	

Example 2

Final Presentation

Traceability

Customer Need	Requirements	Tests	Test Result	Comments
Biocompatible and sterilizable / autoclavable	Components in contact with cells made of autoclavable resin	N/A	N/A	Tested by Dr. Grasman's previous team
Fit in 12 well-plate	Components printed and laser cut to fit in standard 12 well-plate	Test 010 - Dimensions	Pass	
Ability to survive in incubator	Airtight encasement for stepper motor and electronics	Test 015 - Sealability	Pass	
User friendly	Rotary switch to select desired strain & LEDs to show which strain is being run	Test 030 - Entire system test	Pass	
Ability to mechanically actuate	Interaction of all moving parts at maximum strain rate in order to ensure accuracy and effectiveness	Test 021 - Interaction of Actuator, Moving Arm, and Railing	Pass	
Ability to produce 5-15% strain	Stepper motor programmed to rotate X steps depending on selected strain %	Test 031 - Strain accuracy Test 032 - Homing procedure	Pass	

Example 3

Midterm Presentation

Traceability

Customer Need	Req.	Test Plan	Test Results	Comments
<ul style="list-style-type: none"> • Accurately measures forces during exoskeleton use 	REQ230 - REQ250 REQ310 - REQ370 (System Testing Requirements)	System Test	In-Progress	Force values are able to be measured. Right IKB testing complete.
<ul style="list-style-type: none"> • Consistently measure forces 	REQ410 - REQ420 REQ510 - REQ540 (System Testing Requirements)	System Test	In-Progress	Calibrated sensor allows for consistent force readings.
<ul style="list-style-type: none"> • Accurately measures forces during exoskeleton use 	Req 110 (Dimension Requirements)	Knee Offset Test	In-Progress	Knee Offset test was successfully completed with a 3D printed side piece. Pending manufactured piece.
<ul style="list-style-type: none"> • No alteration to human-robot interaction in the exoskeleton or system dynamics 	Req 130 (Dimension Requirements)	Knee Offset Test	In-Progress	Instrumented knee bracket still has the same settings and range of motion as the original.

Example 3

Final Presentation

Traceability

Customer Need	Req.	Test Plan	Test Results	Comments
<ul style="list-style-type: none"> Accurately measures forces during exoskeleton use 	REQ310 - REQ370 (System Testing Requirements)	System Test	Pass	Force values are able to be measured.
<ul style="list-style-type: none"> Consistently measure forces 	REQ510 - REQ520 (System Testing Requirements)	System Test	Pass	Calibrated sensor allows for consistent force readings.
<ul style="list-style-type: none"> Accurately measures forces during exoskeleton use 	Req 110 - Req 130 (Dimension Requirements)	Knee Offset Test	Pass	IKB knee offset is within range of original bracket, allows for subject to be properly fitted
<ul style="list-style-type: none"> No alteration to human-robot interaction in the exoskeleton or system dynamics 	Req 110 - Req 130 (Dimension Requirements)	Knee Offset Test	Pass	Instrumented knee bracket still has the same settings and range of motion as the original.