

P09023 RISK ASSESSMENT

	CONCERN	RESPONSE	QUALIFICATIONS	CATEGORY
1	Fishing Line that is Being Used as Tendons (connecting muscles to fingers) is Prone to Stretching which Degrades Performance.	As Per P08024 the Lines Could Be Pre-Stretched.	Cable Stretching Should Fall Under 0.25 inches within an Appropriate Lifetime (TBD).	Maintenance
		Less Plastic Material Could Be Implemented.		
2	Improper or Failed Clamps Results in Air Muscle Explosions, Potentially Causing Harm to Others and Obviously Causing Harm to Device.	As Per P08024 the Use of Hose Clamps has been Suggested for Durability.	Air Muscle Explosions are Unacceptable Before, During, or After Hand Operation.	Air Muscle Quality Control
3	Passive Finger Position Control Material is Not Robust and is Not Cost Effective due to Amount of Repairs Required.	Pairs of Air Muscles Can Be Implemented to Create all Hand Motions and Their Opposition.	Hand Repairs Should be Infrequent and Should Occur Less than an Appropriate Lifetime (TBD).	Maintenance
		Use a Paired Air Muscle and Spring, Allowing the Spring to Return the Hand to a Neutral Position and Allow the Muscle to Move the Hand Under Control.		
4	Inherent Leakiness of Air Muscles Could Undermine Control System that is Based Upon the Ability to Leave Air Muscles Filled to A Desired Constant Volume.	Use of Barbed Fittings on Air Muscle Ends.	Air Muscles Should Be Controllable per Design, i.e. Able to Hold a Constant Pressure for an Appropriate Lifetime (TBD).	Air Muscle Quality Control
		Implementation of a Vacuum Plenum to Control Exhaust Air Flow.		
		Use Softer More Pliable Hose Material So That It Better Conforms to Fittings and Prevents Extra Leaking.		
5	Having a Large Number of Air Muscles (23 to 46) Will Be Bulky and Hard to Package Neatly.	Reduce the Number of Air Muscles as Much as Possible via Springs.	No Matter the Number of Muscles, the Assembly Should Be Mobile and Accessible for Display Purposes and Easy to Repair.	Aesthetics
		Design the Packaging after Completing Construction.		
		Position Air Muscles in Horizontal or Vertical Layers or At An Angle (Tepee Design).		
6	Palm Motion Must Be Available to Aid in Finger Motions for Complete Anatomical Accuracy	Rubber Bindings and Air Muscles at Certain Joints Will Keep the Palm In Control and Anatomical Accurate.	Hand will Have the Ability to Perform ASL Finger Spelling.	Anatomical Accuracy
7	Fingers Must Be Able to Move Rotationally as Well as Axially via the Controls and Mechanics.	Entirely New Finger Designs contrasting P08034 and P08024 that is Fully Machined	Range of Motion Chart Must Be Met (See EDGE).	Anatomical Accuracy
		Standard Parts Design, Still Maintaining the Concept of Original Concept. Rubber Bindings to Allow Fluid Motion in Joints of Non-Control.		

8	Possible Cable Binding if Run through the Fingers to the Joints.	Modify Design to Route Cables Outside Fingers, More Like Actual Tendon Connections.	Range of Motion Chart Must Be Met (See EDGE).	Anatomical Accuracy
9	Finger Weights Could Be Too Much for Control, But Light Fingers Could Fail to be Robust.	Design Team will Perform Extensive Force Analysis to Assess Parts in Consideration of Cost and Feasibility.	Range of Motion Chart Must Be Met (See EDGE).	Anatomical Accuracy
10	Springs May Not Be Able to Provide 1:1 Control Compared to Air Muscles.	Design will Accommodate All Air Muscles (46) but Will Start with Springs and Replace with Air Muscles when Necessary.	Range of Motion Chart Must Be Met (See EDGE).	Anatomical Accuracy
11	There Are Many Delays in the System which Are Often Variable or Individually Unquantifiable.	A Relatively Simple Controls Scheme Based on Extensive Testing and Maintaining a Neutral State Between Commands (Motions) is to be Implemented.	Range of Motion Chart Must Be Met (See EDGE).	Controls
12	Larger Valves Provide Faster Response, but it is Often Disproportionate to their Cost.	Choose Valves Based on Sample Testing and Control Scheme Timing Requirements.	Cost Must be Kept Down and Budget Must be Approved.	Cost
		Keep Design Open to Future Enhancement in Valve Sizes and/or Timings.		
13	Previous Control Schemes are Lacking in Extensibility and Ease of Use.	New Control Scheme is in Design in Tandem with the Mechanical Team to allow for a Unified Design.	Controls Must Be Accurate, Extensible, and Easily Understood.	Controls
14	Previous Generation Documentation is Lost, Indecipherable, or Poorly Organized.	Documentation will Be Clear and In Tandem with Design, and will be open to Full Disclosure.	Any Future Teams Should Have Full, Immediate Access to all our Complete and Incomplete Work in MSD.	Extensibility
		EDGE is being Redesigned for our Team in Order to Better Organize and Present Documentation.		
16	Custom Parts can Make the Hand Much Harder to Reproduce or Repair.	Extensive Documentation will be Kept and Left in terms of All Custom Parts.	This Should Be Treated as a Prototype Design that Will Be Reproducible and Scalable in the Future.	Manufacturability
		As Much of the Design as Possible will be Constructed from "Off the Shelf" Parts, Easily Reproduced.		
17	The Number of USB Devices May Not be Easily Implemented.	Extensive Testing will be Done Early to Allow for a Hardware Redesign if Necessary.	Design Must be Mobile and Relatively Simple to Setup and Use.	Controls
		Implementation of a Mix of Devices is Possible.		