For wire cable harness builds for outer space environments and use, one must consider several issues and limitations. You always want to construct a cable harness that is light weight, but will handle the requirements and current for mission success.

Sample Exercise:

Wire Sizing: Design the two wire cable harness assemblies to supply power to the Liquid Apogee Engine (LAE) from the Scale-able Power Regulating Unit (SPRU) and through the Fuse Box Assembly (FBA). Here are your givens & requirements & Restrictions:

- The LAE steady state current is 0.80 amps. (Your wire size needs to be the lightest wire that handle this current. Use twisted pair where feasible)
- Length from the SPRU to the FBA is 38 inches.
- Length from the FBA to the bracket ICB300 is 42 inches.
- The length from the SPRU to the bracket ICB300 is 36 inches.
- The length from the bracket ICB300 to the LAE is 276 inches.
- The SPRU connectors only accept 24 AWG & 22 AWG size wire.
- The FBA, ICB300, & LAE can accept 24 AWG, 22 AWG, & 20 AWG size wire.
- The Voltage Drop From the SPRU, FBA to the LAE & back, [(Length) X (wire resistance) X (unit amps)] must be less than or equal to 1 volt.
- Use diagram & table below.
- List the wire part numbers used and where. Calculate the Voltage Drop of each cable individually then add together.

Wire Type	Wire Size AWG	Part No	DESCRIPTION	* Max Derated Current	Wire Resistance Ohms/1000 ft	Weight LBS/foot
SC	22	001	WIRE, SPEC 55, SILVER COATED COPPER, 22 AWG, WHITE	2.5 amps	15.10	0.00270
SC	22	002	WIRE, SPEC 55, SILVER COATED COPPER, 22 AWG, RED	2.5 amps	15.10	0.00270
SC	22	003	WIRE, SPEC 55, SILVER COATED COPPER, 22 AWG, BLUE	2.5 amps	15.10	0.00270
T2	24	004	WIRE, SPEC 55, TWISTED, SILVER / HI-S COPPER, 24 AWG, BLUE & WHITE	2.0 amps	28.40	0.00358
T2	22	005	WIRE, SPEC 55, TWISTED, SILVER / COPPER, 22 AWG, BLUE & WHITE	2.5 amps	15.10	0.00540
T2	20	006	WIRE, SPEC 55, TWISTED, SILVER / COPPER, 20 AWG, BLUE & WHITE	3.7 amps	9.19	0.00858
			* Wire current derated for space environments			
		SC	Single Conductor			
		T2	Twisted Pair			

Cable 100 design and Voltage Drop Calculation:

Since the SPRU is limited to 24 AWG & 22 AWG, either size may fit. However, the diagram specifically shows wire colors in the layout. Therefore, P/N 001, 002, & 003 will be used to construct the cable assembly.

The voltage drop calculation is total length or round trip length (L) times the resistance (R) times the steady state current (I). $V_{Drop\ 1} = L*R*I$. The round trip length for Cable 100 is from the SPRU to the FBA to the ICB300 & back to the SPRU. Equals 38"+42"+36" = 116".

Per the table, the resistance is listed as Ohms per 1000 feet. We need to convert inches to feet. Before we can multiply by the resistance (R) & current (I). The part numbers 001, 002, & 003 all have the resistance of 15.10 Ohms/1000'.

Therefore $V_{Drop\ 1}$ = (116'/12 ')*(15.10/1000')*(0.80 amps) = 0.1168 Volts

Cable 102 design and Voltage Drop Calculation:

The ICB300 & the LAE can handle all wire sizes, and the diagram shows white & blue wire, & this is a good opportunity to use twisted pairs (T2). Therefore we want to choose between P/Ns 004, 005, or 006. Remember weight is a factor as well. Choose the lightest that can support the current & voltage drop requirement.

The roundtrip length is from the ICB300 to the LAE and back to the ICB300. Or 276"+276" = 552". Choosing P/N 005 for this calculation reveals the Voltage drop of Cable 102 to be:

$V_{Drop\ 2}$ = (552'/12 ')*(15.10/1000')*(0.80 amps) = 0.5557 Volts

The total Voltage drop of the circuit is: $V_{Drop\ total} = V_{Drop\ 1} + V_{Drop\ 2}$

$V_{Drop\ total}$ = 0.1168 + 05557 = 0.6725 Volts

Using P/N 004 would result in a lighter cable but would exceed the voltage drop requirement, as for P/N 006 would satisfy the voltage drop requirement, but is heavier than the P/N 005 wire.