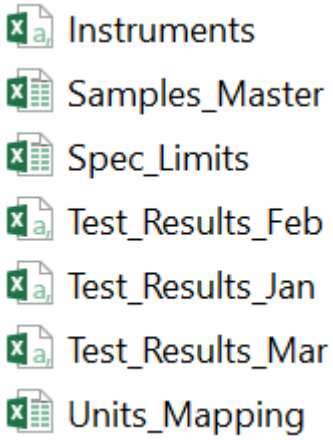
R&D Consulting – Materials Testing

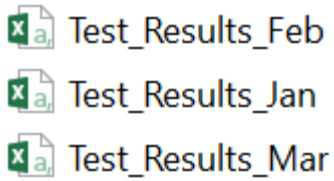
Portfolio Project – Demo Data

Workflow Overview part 1

Data Source:



Power Query to combine:



into one table (Worksheet: AllResults)

Tasks:

- Used **From Folder** to import ‘Test_Results_*.csv’ and append.
- Handled different delimiters (‘,’ vs ‘;’) and decimal formats (‘,’ vs ‘.’).
- Trimmed header whitespace and standardize column names (‘ResultValue’/’Result’ → ‘ResultValue’, ‘Result_Unit’/’ResultUnit’ → ‘Result_Unit’, ‘PressUnit’/’Pressure_Unit’ → ‘PressUnit’).
- Organized columns in the correct order
- Added a `Month` column from file name.

Workflow Overview part 2

2. **Normalize units**
- Convert Temperature to **°C** (K → °C), Pressure to **MPa** (kPa → MPa).
- Convert Result values to canonical units depending on **TestType** (new column: ‘Results(properUnits)’):
  - Tensile → MPa (already),
  - Viscosity → Pa·s (mPa·s ÷ 1000),
  - Conductivity → S/m (mS/cm·0.1).

3. **Clean values**
- Converted text “NaN” and blanks to proper missing.
- Removed exact duplicate rows.
- Trimmed text, fix casing.

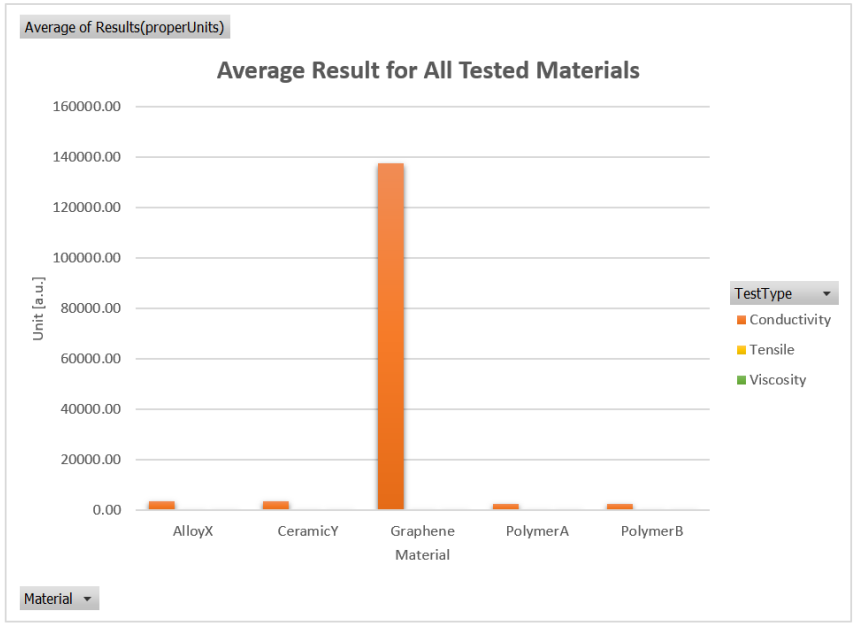
4. **Enrich with metadata**
- Used ‘Samples_Master.xlsx’ to add ‘Material, MaterialFamily, Batch, Project’.
- Standardize material typos: ‘Graphen’, ‘Graphn’ → ‘Graphene’.

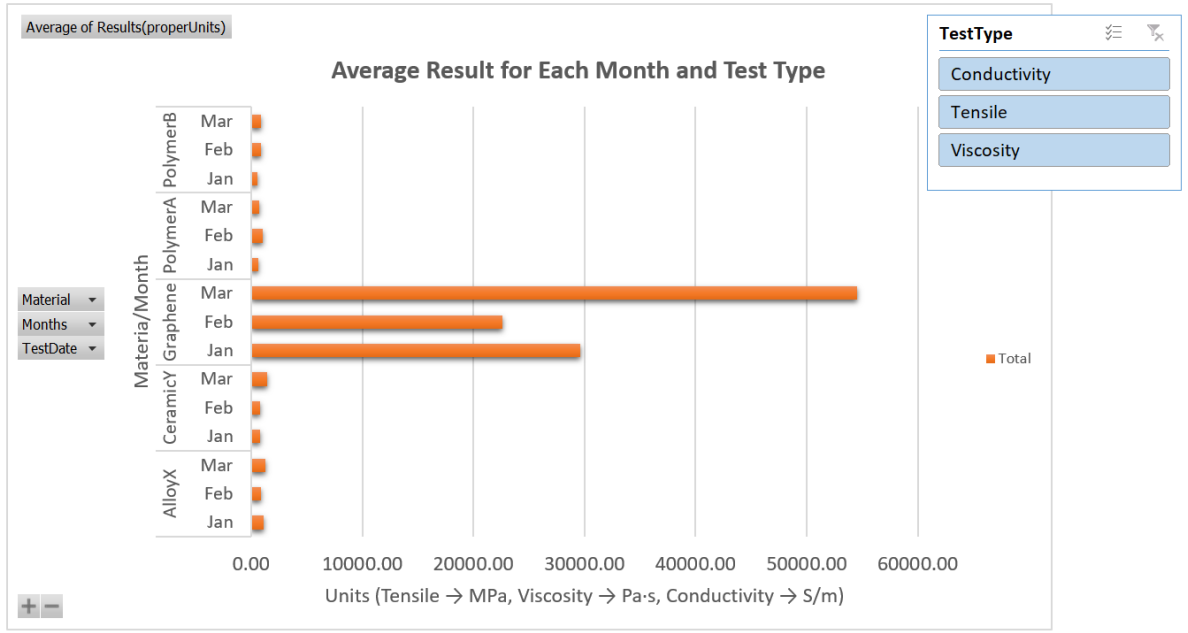
5. **Join Spec Limits & compute Pass/Fail**
- Joined ‘Spec_Limits.xlsx’ on ‘(Material, TestType)’ to get ‘Min_Result’, ‘Max_Result’, ‘Result_Unit_Canonical’.
- Created ‘Fail/Pass’ column depending if ‘Results(properUnits)’ within ‘[Min, Max]’.

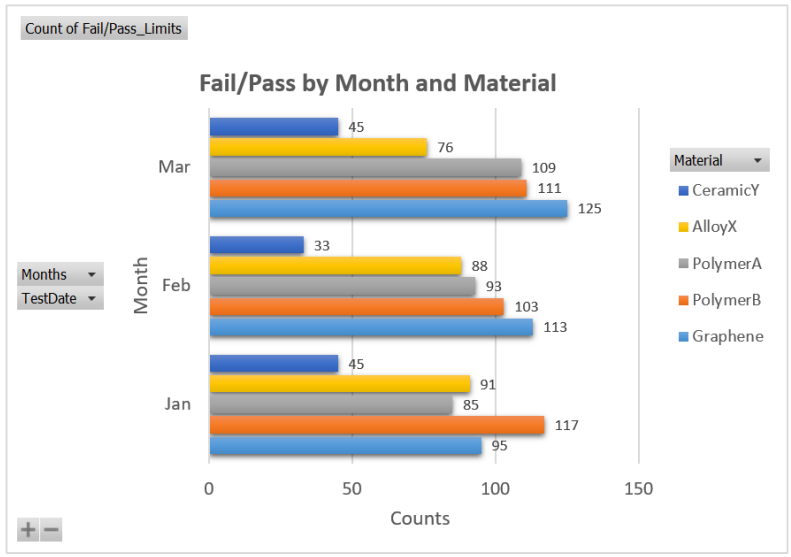
6. **Build analysis & dashboard** (next slides).

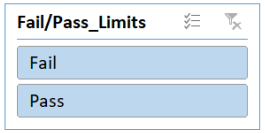
Main Dashboard

Report for the Customer - Materials Testing









Average Value for each Test Type and Material

Material	Conductivity (S/m)	Tensile (MPa)	Viscosity (Pa·s)
AlloyX	3392.45	88.98	201.80
CeramicY	3650.11	70.04	341.28
Graphene	137607.48	84.52	190.03
PolymerA	2459.86	69.36	349.63
PolymerB	2565.55	69.55	321.79

Test Type	% Errors Results
Viscosity	1.3
Tensile	0.6
Conductivity	0.0

Material	% Errors Temperatur
Graphene	0.3
PolymerB	0.0
PolymerA	5.0
AlloyX	3.1
CeramicY	6.1

More insights about Test Results that failed to fit Spec_Limits

Count of Fail/Pass_Limits	Column Labels			
	Jan	Feb	Mar	Grand Total
Row Labels				
INS010	6	10	10	26
INS005	7	6	10	23
INS004	6	7	7	20
INS015	3	6	10	19
INS002	5	6	8	19
INS006	6	7	6	19
INS012	7	10	1	18
INS003	6	5	6	17
INS001	7	4	6	17
INS011	6	4	6	16
INS007	6	4	6	16
INS014	3	5	6	14
INS009	5	4	4	13
INS013	4	3	5	12
INS008	2	4	6	12
Grand Total	**79**	**85**	**97**	**261**

Count of Fail/Pass_Limits	Column Labels			
	Jan	Feb	Mar	Grand Total
Row Labels				
Graphene	22	19	33	74
PolymerB	14	24	19	57
AlloyX	22	16	17	55
PolymerA	12	21	18	51
CeramicY	9	5	10	24
Grand Total	**79**	**85**	**97**	**261**

Fail/Pass_Limits

Fail

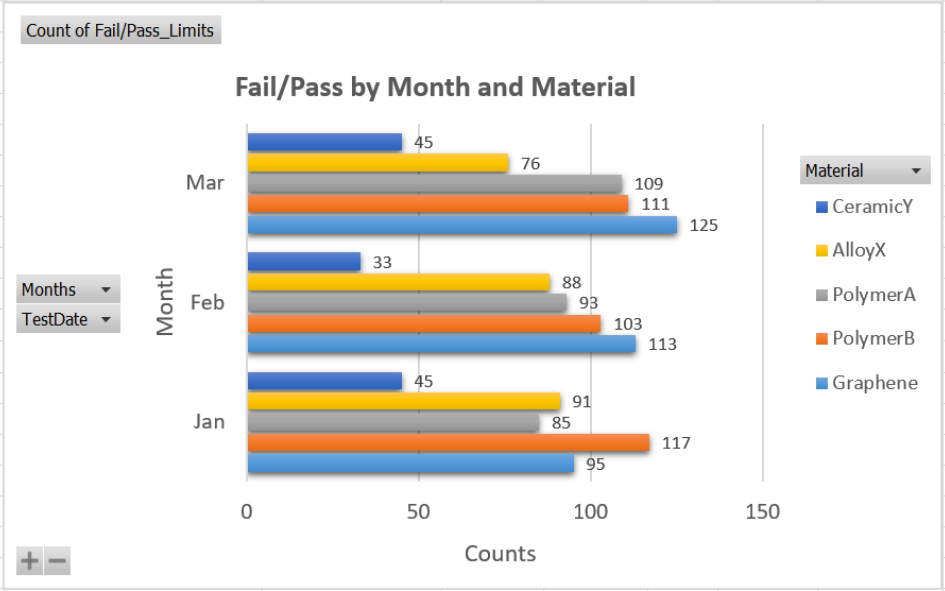
Pass

Fail/Pass_Limits

Fail

Pass

Count of Fail/Pass_Limits	Column Labels					
Row Labels	Graphene	PolymerB	PolymerA	AlloyX	CeramicY	Grand Total
Jan	**95**	**117**	**85**	**91**	**45**	**433**
Feb	**113**	**103**	**93**	**88**	**33**	**430**
Mar	**125**	**111**	**109**	**76**	**45**	**466**
Grand Total	**333**	**331**	**287**	**255**	**123**	**1329**



Fail/Pass_Limits

Fail

Pass

More insights about Errors within the Results:

SampleID	TestDate	TestType	Result	ResultU	InstrumentID	RunID	Month	Material	MaterialFamily	Batch	Project	FullName	Min_Result	Max_Result	Fail/Pass_Limits	Outliers
S0284	January 23, 2025	Tensile		MPa	INS007	RUN54739	January	Graphene	Carbon	B019	P001	Graphene_Tensile	60.00	120.00	Fail	OK
S0130	January 10, 2025	Viscosity	2.69653970229347E+308	Pa*s	INS009	RUN79345	January	PolymerB	Polymer	B095	P004	PolymerB_Viscosity	0.50	2.50	Fail	Check
S0172	January 18, 2025	Tensile	#NUM!	MPa	INS014	RUN75066	January	Graphene	Carbon	B096	P002	Graphene_Tensile	60.00	120.00	#NUM!	#NUM!
S0079	January 26, 2025	Viscosity		mPa*s	INS001	RUN19130	January	PolymerA	Polymer	B100	P001	PolymerA_Viscosity	0.50	2.50	Fail	OK
S0239	January 12, 2025	Conductivity		mS/cm	INS006	RUN94523	January	PolymerB	Polymer	B018	P002	PolymerB_Conductivity	100.00	2000.00	Fail	OK
S0081	January 25, 2025	Viscosity	-0.011	Pa*s	INS004	RUN49263	January	AlloyX	Metal	B094	P001	AlloyX_Viscosity	0.20	1.50	Fail	OK
S0081	January 1, 2025	Tensile		MPa	INS005	RUN33777	January	AlloyX	Metal	B094	P001	AlloyX_Tensile	60.00	120.00	Fail	OK
S0184	January 22, 2025	Viscosity	-51.724	mPa*s	INS001	RUN96807	January	AlloyX	Metal	B099	P001	AlloyX_Viscosity	0.20	1.50	Fail	OK
S0060	February 22, 2025	Conductivity		S/m	INS015	RUN22521	February	PolymerA	Polymer	B057	P004	PolymerA_Conductivity	100.00	2000.00	Fail	OK
S0022	February 19, 2025	Viscosity	-0.309	Pa*s	INS012	RUN30229	February	Graphene	Carbon	B090	P002	Graphene_Viscosity	0.20	1.50	Fail	OK
S0140	February 18, 2025	Conductivity		mS/cm	INS006	RUN48294	February	CeramicY	Ceramic	B093	P001	CeramicY_Conductivity	100.00	2000.00	Fail	OK
S0067	February 24, 2025	Tensile	#NUM!	MPa	INS015	RUN97340	February	Graphene	Carbon	B094	P004	Graphene_Tensile	60.00	120.00	#NUM!	#NUM!
S0292	February 19, 2025	Tensile		MPa	INS006	RUN63205	February	Graphene	Carbon	B020	P001	Graphene_Tensile	60.00	120.00	Fail	OK
S0298	February 6, 2025	Viscosity	#NUM!	Pa*s	INS005	RUN52407	February	PolymerA	Polymer	B001	P001	PolymerA_Viscosity	0.50	2.50	#NUM!	#NUM!
S0137	February 8, 2025	Tensile		MPa	INS006	RUN16565	February	PolymerB	Polymer	B081	P001	PolymerB_Tensile	40.00	100.00	Fail	OK
S0212	March 5, 2025	Viscosity		Pa*s	INS015	RUN76909	March	PolymerB	Polymer	B016	P004	PolymerB_Viscosity	0.50	2.50	Fail	OK
S0288	March 16, 2025	Conductivity		S/m	INS005	RUN95870	March	PolymerB	Polymer	B013	P002	PolymerB_Conductivity	100.00	2000.00	Fail	OK
S0100	March 15, 2025	Tensile		MPa	INS013	RUN92915	March	Graphene	Carbon	B024	P002	Graphene_Tensile	60.00	120.00	Fail	OK
S0063	March 28, 2025	Viscosity	#NUM!	Pa*s	INS014	RUN96290	March	AlloyX	Metal	B092	P004	AlloyX_Viscosity	0.20	1.50	#NUM!	#NUM!
S0144	March 9, 2025	Tensile		MPa	INS007	RUN27399	March	PolymerA	Polymer	B034	P001	PolymerA_Tensile	40.00	100.00	Fail	OK
S0150	March 12, 2025	Tensile	#NUM!	MPa	INS014	RUN75035	March	PolymerA	Polymer	B117	P002	PolymerA_Tensile	40.00	100.00	#NUM!	#NUM!

Sample_ID

Row Labels	Count of Result
S0172	1
S0298	1
S0130	1
S0063	1
S0150	1
S0067	1
S0184	1
S0081	1
S0022	1
S0284	
S0212	
S0292	
S0144	
S0239	
S0100	
S0288	
S0079	
S0060	
S0137	
S0140	
Grand Total	9

Batch

Row La	Count of Result
B094	2
B095	1
B099	1
B001	1
B096	1
B090	1
B092	1
B117	1
B024	
B019	
B100	
B013	
B020	
B016	
B034	
B018	
B093	
B057	
B081	
Grand Tot	9

Test Type and Material (Errors)

Count of Res	Column Labels					
Row Labe	AlloyX	CeramicY	Graphene	PolymerA	PolymerB	Grand Total
Viscosity	3		1	1	1	6
Tensile			2	1		3
Conductivity						
Grand Total	3		3	2	1	9

Test Type and Material (All Measurements)

Count of Res	Column Labels					
Row Labe	AlloyX	CeramicY	Graphene	PolymerA	PolymerB	Grand Total
Tensile	106	55	140	108	126	535
Viscosity	73	38	102	105	127	445
Conductivity	75	29	88	71	74	337
Grand Total	254	122	330	284	327	1317

	% Errors
Viscosity	1.33
Tensile	0.56
Conductivity	0.00

Project

Row Label	Count of Result
P001	3
P002	3
P004	3
Grand Total	9

Material

Row Labels	Count of Result
AlloyX	3
Graphene	3
PolymerA	2
PolymerB	1
CeramicY	
Grand Total	9

More insights about Errors in Temperature measurements:

SampleID	TestDate	TestType	Temperature	TempUnit	InstrumentID	RunID	Temperatu	Month	Material	MaterialFamily	Batch	Project	FullName
S0199	January 25, 2025	Conductivity		°C	INS015	RUN68608		January	AlloyX	Metal	B012	P004	AlloyX_Conductivity
S0228	January 24, 2025	Tensile	29.79	K	INS007	RUN53884	-243.36	January	PolymerA	Polymer	B042	P004	PolymerA_Tensile
S0228	January 10, 2025	Tensile	26.74	K	INS007	RUN95076	-246.41	January	PolymerA	Polymer	B042	P004	PolymerA_Tensile
S0216	January 28, 2025	Viscosity		°C	INS015	RUN99211		January	PolymerA	Polymer	B012	P004	PolymerA_Viscosity
S0181	January 24, 2025	Tensile		K	INS015	RUN39768		January	PolymerA	Polymer	B013	P002	PolymerA_Tensile
S0179	January 26, 2025	Conductivity	26.76	K	INS004	RUN35901	-246.39	January	CeramicY	Ceramic	B113	P004	CeramicY_Conductivity
S0179	January 11, 2025	Viscosity	26.35	K	INS012	RUN51430	-246.80	January	CeramicY	Ceramic	B113	P004	CeramicY_Viscosity
S0138	January 18, 2025	Viscosity		K	INS006	RUN32490		January	AlloyX	Metal	B090	P002	AlloyX_Viscosity
S0034	January 23, 2025	Viscosity	19.99	K	INS014	RUN32092	-253.16	January	CeramicY	Ceramic	B111	P001	CeramicY_Viscosity
S0040	January 5, 2025	Conductivity	22.82	K	INS012	RUN23569	-250.33	January	PolymerA	Polymer	B104	P001	PolymerA_Conductivity
S0152	February 25, 2025	Conductivity		K	INS015	RUN48034		February	PolymerA	Polymer	B109	P002	PolymerA_Conductivity
S0008	February 22, 2025	Conductivity	24.45	K	INS011	RUN11160	-248.70	February	AlloyX	Metal	B040	P004	AlloyX_Conductivity
S0114	February 20, 2025	Tensile		K	INS009	RUN74226		February	AlloyX	Metal	B033	P001	AlloyX_Tensile
S0030	February 3, 2025	Tensile		°C	INS011	RUN49322		February	Graphene	Carbon	B117	P004	Graphene_Tensile
S0034	February 14, 2025	Conductivity	18.67	K	INS006	RUN88250	-254.48	February	CeramicY	Ceramic	B111	P001	CeramicY_Conductivity
S0093	February 10, 2025	Tensile		°C	INS015	RUN59262		February	AlloyX	Metal	B058	P001	AlloyX_Tensile
S0093	February 12, 2025	Viscosity	26.3	K	INS014	RUN41969	-246.85	February	AlloyX	Metal	B058	P001	AlloyX_Viscosity
S0093	February 23, 2025	Tensile	22.07	K	INS010	RUN97148	-251.08	February	AlloyX	Metal	B058	P001	AlloyX_Tensile
S0179	February 25, 2025	Viscosity	21.06	K	INS010	RUN38415	-252.09	February	CeramicY	Ceramic	B113	P004	CeramicY_Viscosity
S0237	March 26, 2025	Conductivity	32.95	K	INS001	RUN39394	-240.20	March	PolymerA	Polymer	B107	P002	PolymerA_Conductivity
S0237	March 7, 2025	Viscosity	21.99	K	INS002	RUN10129	-251.16	March	PolymerA	Polymer	B107	P002	PolymerA_Viscosity
S0003	March 19, 2025	Viscosity		K	INS005	RUN85503		March	AlloyX	Metal	B116	P001	AlloyX_Viscosity
S0062	March 18, 2025	Viscosity		°C	INS001	RUN31883		March	PolymerA	Polymer	B078	P002	PolymerA_Viscosity
S0040	March 14, 2025	Conductivity	20.96	K	INS014	RUN14629	-252.19	March	PolymerA	Polymer	B104	P001	PolymerA_Conductivity
S0040	March 28, 2025	Viscosity	35.47	K	INS014	RUN60606	-237.68	March	PolymerA	Polymer	B104	P001	PolymerA_Viscosity
S0040	March 16, 2025	Viscosity	20.07	K	INS015	RUN49137	-253.08	March	PolymerA	Polymer	B104	P001	PolymerA_Viscosity
S0179	March 10, 2025	Tensile	26.44	K	INS009	RUN23140	-246.71	March	CeramicY	Ceramic	B113	P004	CeramicY_Tensile
S0090	March 16, 2025	Conductivity		K	INS001	RUN33618		March	PolymerB	Polymer	B095	P002	PolymerB_Conductivity
S0034	March 24, 2025	Tensile	23.79	K	INS002	RUN87195	-249.36	March	CeramicY	Ceramic	B111	P001	CeramicY_Tensile
S0034	March 16, 2025	Viscosity	24.38	K	INS004	RUN91646	-248.77	March	CeramicY	Ceramic	B111	P001	CeramicY_Viscosity
S0228	March 23, 2025	Tensile	21.3	K	INS011	RUN48377	-251.85	March	PolymerA	Polymer	B042	P004	PolymerA_Tensile
S0228	March 1, 2025	Viscosity	23.21	K	INS006	RUN69893	-249.94	March	PolymerA	Polymer	B042	P004	PolymerA_Viscosity
S0228	March 1, 2025	Viscosity	26.75	K	INS007	RUN49062	-246.40	March	PolymerA	Polymer	B042	P004	PolymerA_Viscosity
S0228	March 9, 2025	Tensile	28.59	K	INS013	RUN63986	-244.56	March	PolymerA	Polymer	B042	P004	PolymerA_Tensile
S0008	March 28, 2025	Viscosity	13.86	K	INS010	RUN24244	-259.29	March	AlloyX	Metal	B040	P004	AlloyX_Viscosity
S0133	March 8, 2025	Conductivity		°C	INS015	RUN89518		March	Graphene	Carbon	B115	P004	Graphene_Conductivity

Sample_ID

Row Labels	Count of Temperature
S0228	**6**
S0040	4
S0179	4
S0034	4
S0093	3
S0008	2
S0237	2
S0181	1
S0199	1
S0216	1
S0152	1
S0030	1
S0138	1
S0114	1
S0133	
S0003	
S0090	
S0062	
Grand Total	**32**

Batch

Row Labels	Count of Temperature
B042	**6**
B111	4
B104	4
B113	4
B058	3
B012	2
B107	2
B040	2
B013	1
B109	1
B033	1
B117	1
B090	1
B078	
B116	
B115	
B095	
Grand Total	**32**

Material (Errors)

Row Labels	Count of Temperature
PolymerA	**15**
AlloyX	8
CeramicY	8
Graphene	1
PolymerB	
Grand Total	**32**

Material (All Measurements)

Row Labels	Count of Temperature
Graphene	332
PolymerB	330
PolymerA	286
AlloyX	254
CeramicY	123
Grand Total	**1325**

Material	% Errors Temperature
Graphene	0.30
PolymerB	0.00
PolymerA	4.98
AlloyX	3.05
CeramicY	6.11

Problems and Open Questions

1. Units & Test Types
- Results are aggregated across different test types (Tensile, Viscosity, Conductivity), each with distinct canonical units.
- To avoid misinterpretation, units have been normalized, and a unit legend has been added to the dashboard.
- Open Question: Should reporting always be split per test type to maintain clarity, or is combined reporting acceptable?

2. Temperature Measurements
- Some recorded values are close to 0 K, which is not physically realistic in this testing context
- Likely cause: temperatures exported in °C but labeled as K.
- Open Question: Please confirm correct unit labeling for temperature data.

3. Pressure Values
- Pressure distribution is very narrow, with little variation across samples.
- Pressure vs. Result scatter plots would add no analytical value, so they were excluded.
- Open Question: Should pressure be monitored as a KPI, or is it a controlled/constant parameter?

4. Outliers in Results
- Extremely large values (e.g., 2.7E+308) were detected — likely instrument overflow or data corruption.
- These values have been preserved in raw data, flagged as anomalies, and excluded from KPI calculations.
- Open Question: Should anomalies be removed entirely from reporting, or kept for traceability?

5. Spec Limit Validation
- Current Pass/Fail logic assumes that Spec_Limits.xlsx contains the correct canonical units (MPa, Pa·s, S/m).
- Open Question: Please confirm whether limits should vary further by batch, project, or instrument, or remain material-level only.