



LiB Cell Manufacturing: Unit Operations and Machine Builders, Version 1

August 2025

NAATBatt Equipment Committee

Outline Version 1

1. Objective

2. System level

3. Detailed view – GigaFactory and Pilot

- Electrode Production
- Cell Assembly
 - Cylindrical
 - Prismatic
 - Pouch
- Cell Finishing and Formation

4. Next steps



Objective

Document current condition and plan for updates

Define the current condition machine builders for LiB cell manufacturing based on Equipment Committee participation

Are there system solutions?

What companies can support each unit operation required to build an LiB battery cell?

Publish version 1 in August 2025

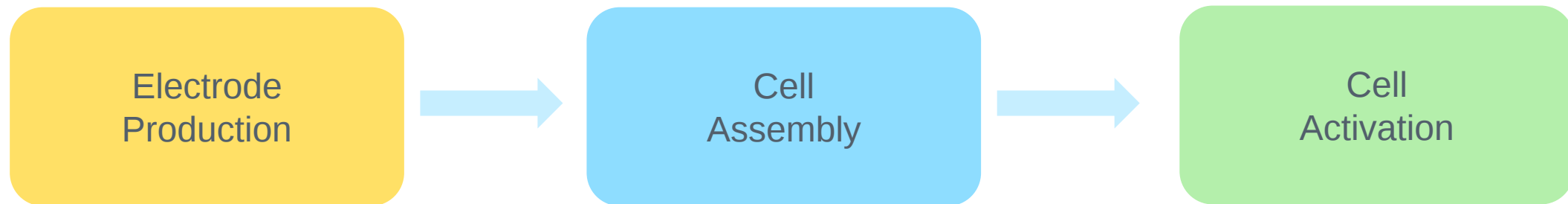
Periodically update

- Every 6 months publish updated version
- Investigate if NREL will maintain along with Supply Chain Database

Note: All NAATBatt member who wish to be included in future updates are encouraged to join the Equipment Makers Committee and participate in future updates.

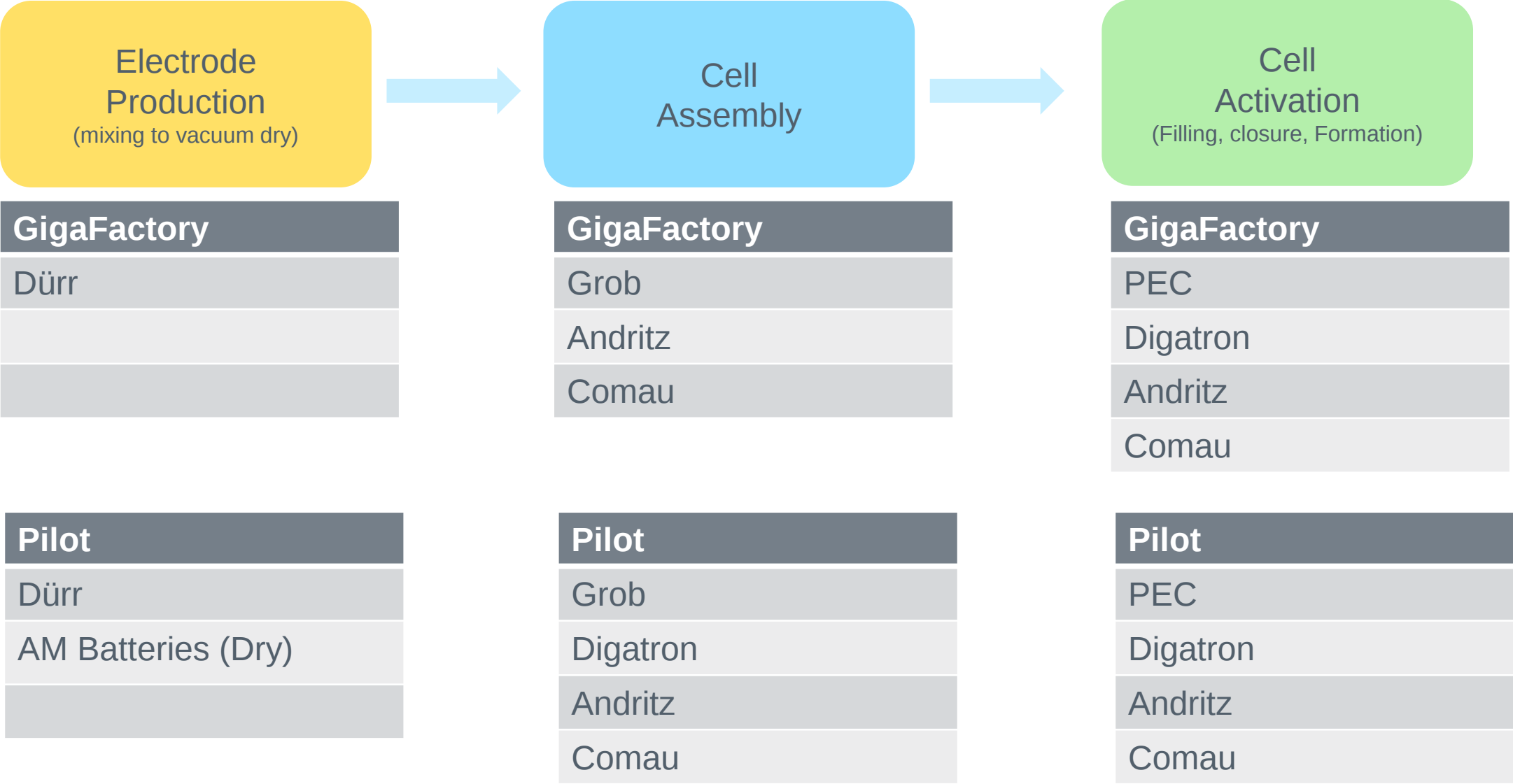
System level view of Cell Manufacturing

3 Main Blocks



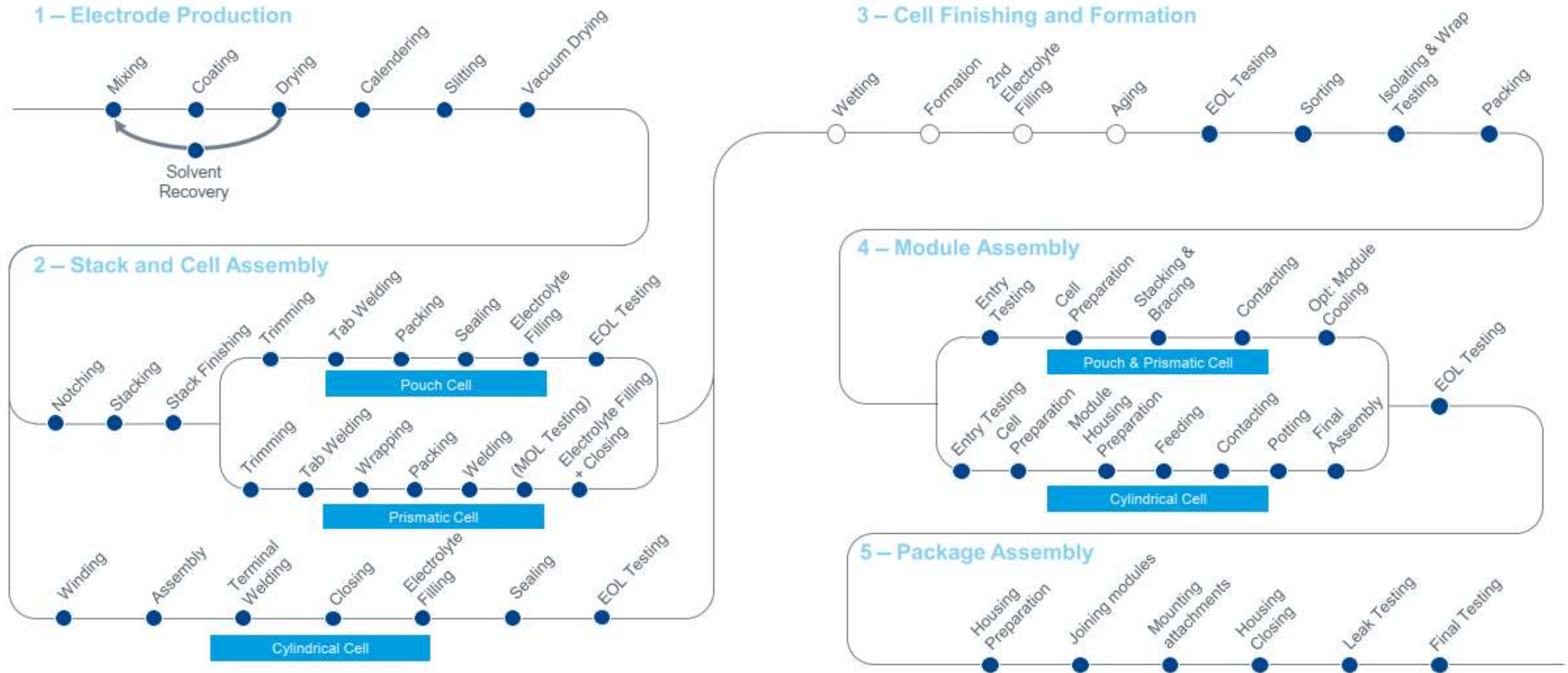
System level of view Cell Manufacturing

3 Main Blocks



Detailed level view of Cell Manufacturing - example

Complete list of steps



Electrode Production – detailed view

Steps required

GigaFactory

Mix	Dry Electrode Process	Wet Coat&Dry	Solvent Recovery	Press	Slit
Netzsch	Naknor (Anode)	Dürr	Airprotech	Saueressig	Kampf
Ross		Delta Modtech	Dürr	IMC	Comexi
Bühler		Jagenberg	Equans	Breyer	Laem IMS
Coperion		Kroenert		Ingecal (Dürr)	Spoollex
Eirich		Davis Standard		Naknor (with slit)	Deacro

Pilot

Mix	Dry Electrode Process	Wet Coat&Dry	Solvent Recovery	Press	Slit
Netzsch	Naknor	Dürr	Airprotech	Saueressig	IMC
Ross	LiCAP	Delta Modtech	Dürr	IMC	Comexi
Bühler	Sakuu	New Era	Equans	Breyer	Laem IMS
Coperion		IMC	Maratek	Ingecal (Durr)	Spoollex
Eirich		Mathis		Naknor (with slit)	Deacro
AM Batteries	AM Batteries			AM Batteries	AM Batteries

Cell Assembly, Cylindrical - detailed view – large format

Steps required

tabless design

GigaFactory

Winding	Assembly	Terminal Welding	Closing	Electrolyte Filling	Sealing	Formation, Age, Test
						Digatron
			PEC	PEC	PEC	PEC
						Arbin
Andritz				Andritz	Andritz	Andritz

Pilot

Winding	Assembly	Terminal Welding	Closing	Electrolyte Filling	Sealing	Formation, Age, Test
Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron
			PEC	PEC	PEC	PEC
						Arbin
Andritz	Andritz	Andritz	Andritz	Andritz	Andritz	Andritz

Cell Assembly, Cylindrical - detailed view; small format



Steps required

Crimped vs tabless design difference

GigaFactory

Winding	Assembly	Terminal Welding	Closing	Electrolyte Filling	Sealing	Formation, Age, test
						PEC
						Digatron
						Arbin
Andritz				Andritz	Andritz	Andritz

Pilot

Winding	Assembly	Terminal Welding	Closing	Electrolyte Filling	Sealing	Formation, Age, test
						PEC
Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron
						Arbin
Andritz	Andritz	Andritz	Andritz	Andritz	Andritz	Andritz

Cell Assembly, Prismatic – detailed view

Steps required

GigaFactory

Notching	Stacking	Stack Finishing	Trimming	Tab Welding	Wrapping	Packing	Welding	MOL Test	Electrolyte Fill and Close
Grob	Grob	Grob	Grob	Grob	Grob	Grob	Grob	Grob	Grob
Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer
									PEC
Andritz	Andritz	Andritz							Andritz

Pilot

Notching	Stacking	Stack Finishing	Trimming	Tab Welding	Wrapping	Packing	Welding	MOL Test	Electrolyte Fill and Close
Grob	Grob	Grob	Grob	Grob	Grob	Grob	Grob	Grob	Grob
Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron
Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer
Andritz	Andritz	Andritz	Andritz	Andritz	Andritz	Andritz	Andritz	Andritz	Andritz
									PEC

Cell Assembly, Pouch – detailed view

Steps required

GigaFactory

Notching	Stacking	Stack Finishing	Trimming	Tab Welding	Packing	Sealing	Electrolyte Filling
Comau	Comau	Comau	Comau	Comau	Comau	Comau	Comau
Grob	Grob	Grob		Grob			
Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer
Andritz	Andritz	Andritz					Andritz

Pilot

Notching	Stacking	Stack Finishing	Trimming	Tab Welding	Packing	Sealing	Electrolyte Filling
Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron
Comau	Comau	Comau	Comau	Comau	Comau	Comau	Comau
Jonas&Redman	Jonas&Redman	Jonas&Redman	Jonas&Redman	Jonas&Redman	Jonas&Redman	Jonas&Redman	Jonas&Redman
Andritz	Andritz	Andritz	Andritz	Andritz	Andritz	Andritz	Andritz
Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer	Mühlbauer

Cell Activation

Steps required

GigaFactory

Wetting	Formation	2 nd Electrolyte Fill	Aging	EOL Test	Sorting	Isolating & Wrap Test	Packing
PEC	PEC	PEC	PEC	PEC	PEC	PEC	PEC
Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron
Andritz	Andritz	Andritz	Andritz	Andritz			
Comau	Comau	Comau	Comau	Comau	Comau	Comau	Comau

Pilot

Wetting	Formation	2 nd Electrolyte Fill	Aging	EOL Test	Sorting	Isolating & Wrap Test	Packing
PEC	PEC	PEC	PEC	PEC	PEC	PEC	PEC
Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron	Digatron
Andritz	Andritz	Andritz	Andritz	Andritz			
Comau	Comau	Comau	Comau	Comau	Comau	Comau	Comau

Support and Infrastructure

DRY ROOMS

- SCS (Scientific Climate Systems)
 - Bry-Air (Dehumidification Systems and Dry Rooms)
 - Pacific Environmental Technologies, Inc.
 - Airtho
-
- Munters – Dehumidifiers only; not dry rooms

CLEAN ROOMS

- Terra Universal
- Allied Cleanrooms

Industrial Ventilation

- Donaldson

EPC (Engineering, Procurement, Construction)

- SSOE
- Turner Construction
- ClayCo (Clay Corp)
- Bechtel
- Hatch

Service Providers

- Precision Roll Grinders (focus on Calender rolls)
- NMP recycling as a service
 - Republic Services
 - Veolia North America
 - BASF

General

Other companies mentioned during discussion

Matthews Engineering – roll to roll (web based) engineering capability; also has group companies for various steps

- Olbrich – coating machines
- Polytype – coating machines and winders
- Saueressig – Calenders/Roll Presses

Owens Desing - Custom Equipment & Factory Automation Solutions

- Unique automation solutions
- Prototypes / low volume manufacturing equipment

DW Fritz - engineered-to-order precision automation solutions with limited cell manufacturing experience

(<https://dwfritz.com/en/industries/automotive-and-e-mobility/>)

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“Subject to change. The information in this presentation contains only general descriptions or performance characteristics, which may vary in different cases. The requested performance characteristics are only binding if they are expressly agreed in the contract.”

