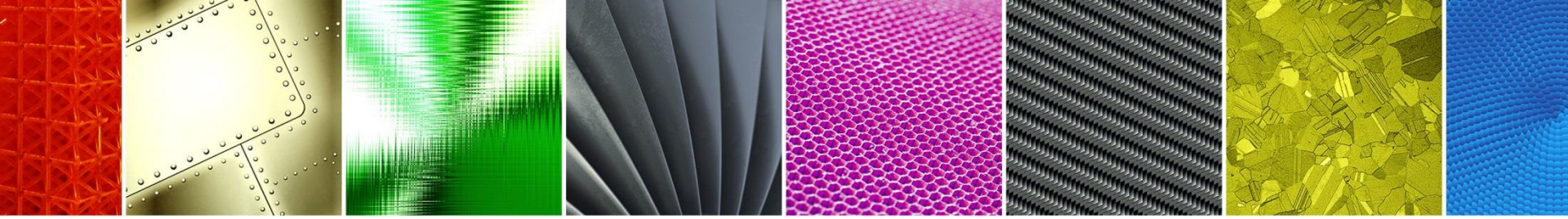

CES Selector: On-line training

Defining Design Requirements

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MATERIAL INTELLIGENCE

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Agenda

Defining Design Requirements

Q&A

Presenter: Paul MacDonald

- **What are design requirements/constraints?**
- **Common techniques used to identify constraints**
- **Using *CES Selector* to find suitable design constraints**

What are Design Requirements?

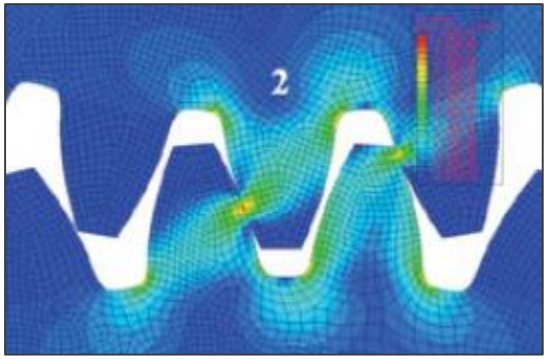
- Key properties and characteristics of a material…

  required for a part to function over its complete lifecycle.

Defining Design Constraints

Common Techniques

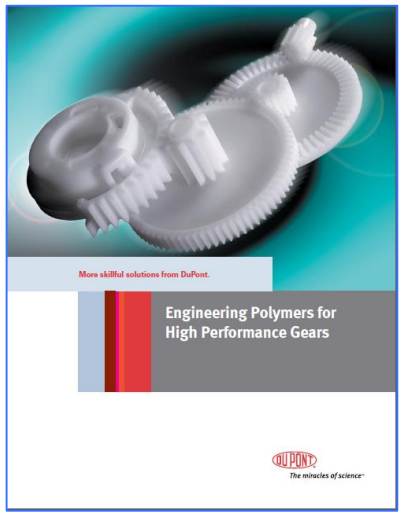
1) Use experience of similar products & applications
2) Contact colleagues, suppliers, consultants (questionnaire)
3) See what materials competitors are using
4) Search internet for expert articles
5) CAE modelling of component




engineering principles for PLASTIC GEARS

By Brady Walter

In many instances, plastic materials perform markedly better than do metals—especially in gears. Read on to learn the details that will allow you to make the best choice for your operation.

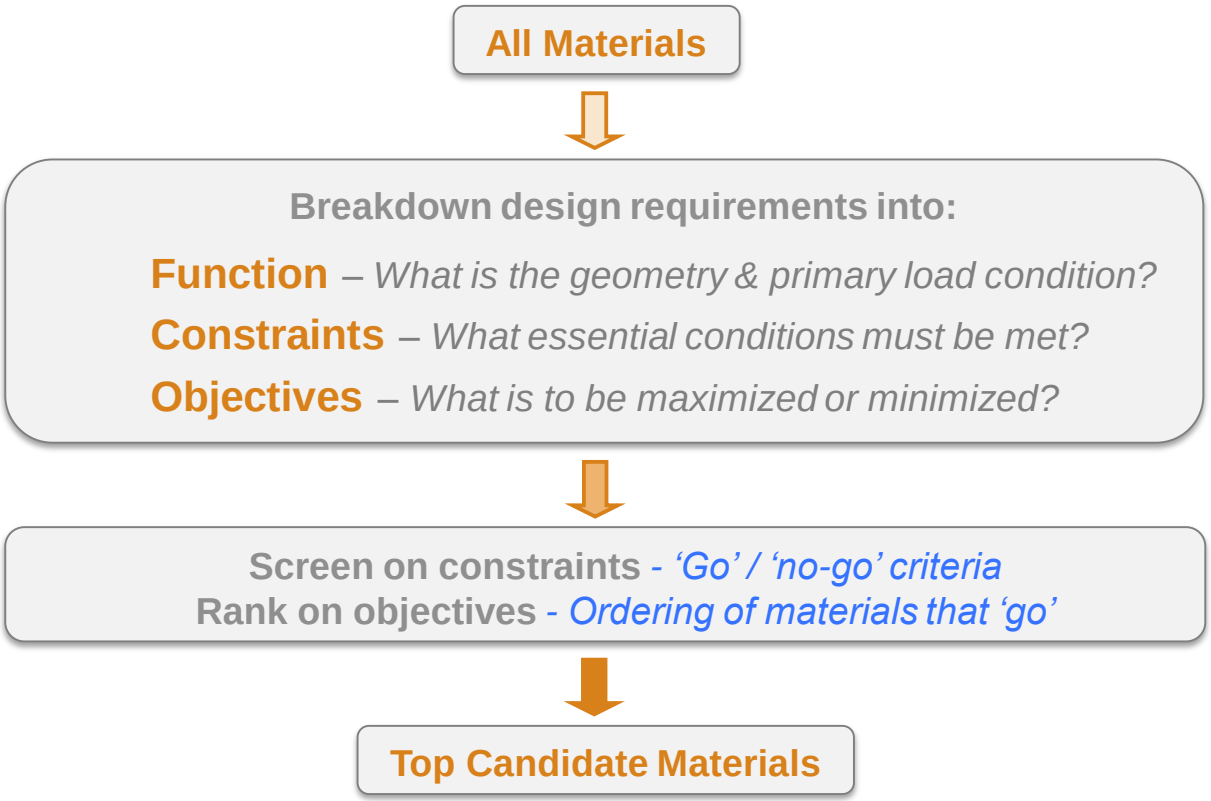


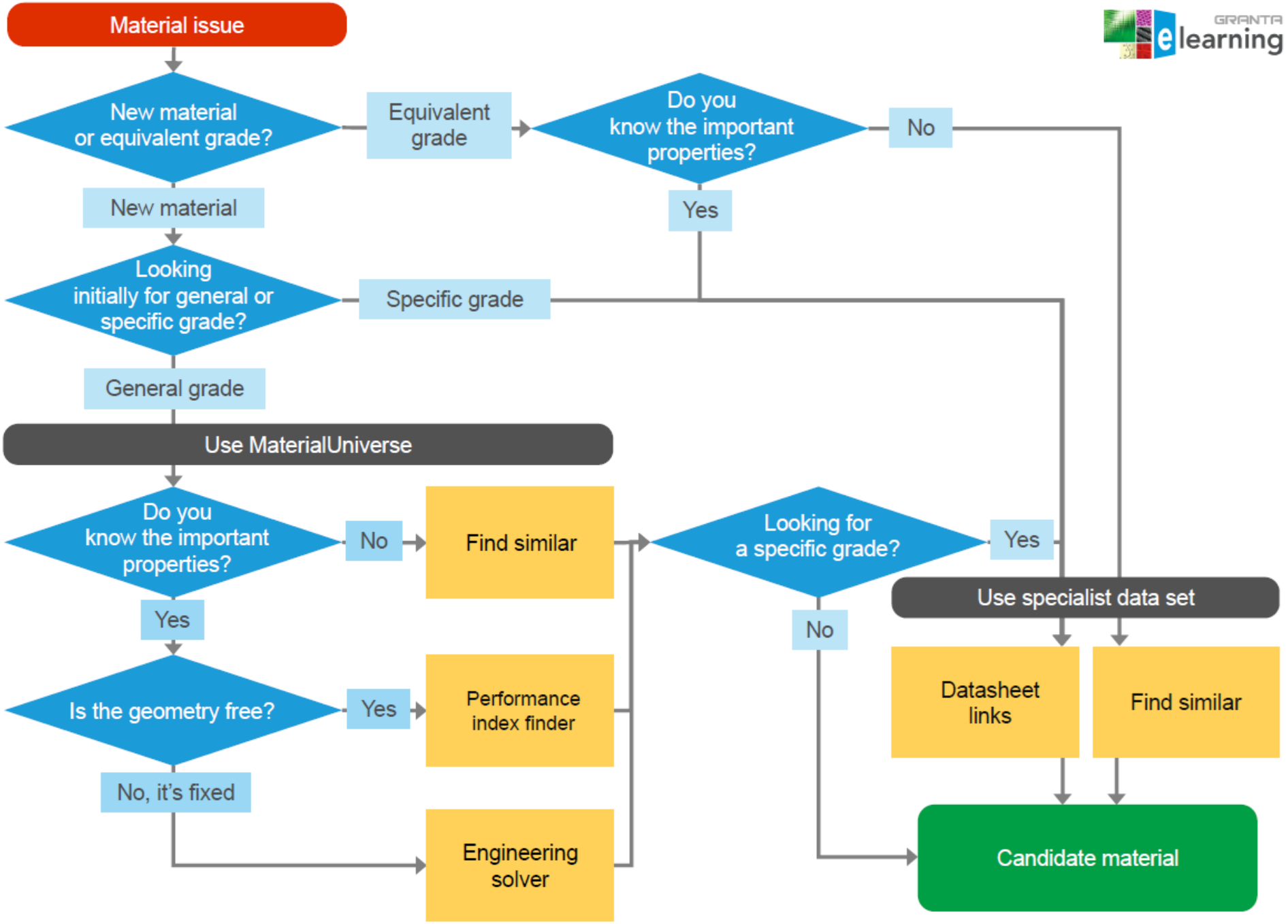
"…Metal gears usually operate well within the temperature limits of the material. The design of plastic gears, however, must always take into consideration the increase in temperature which is caused by friction, pressure, and speed."

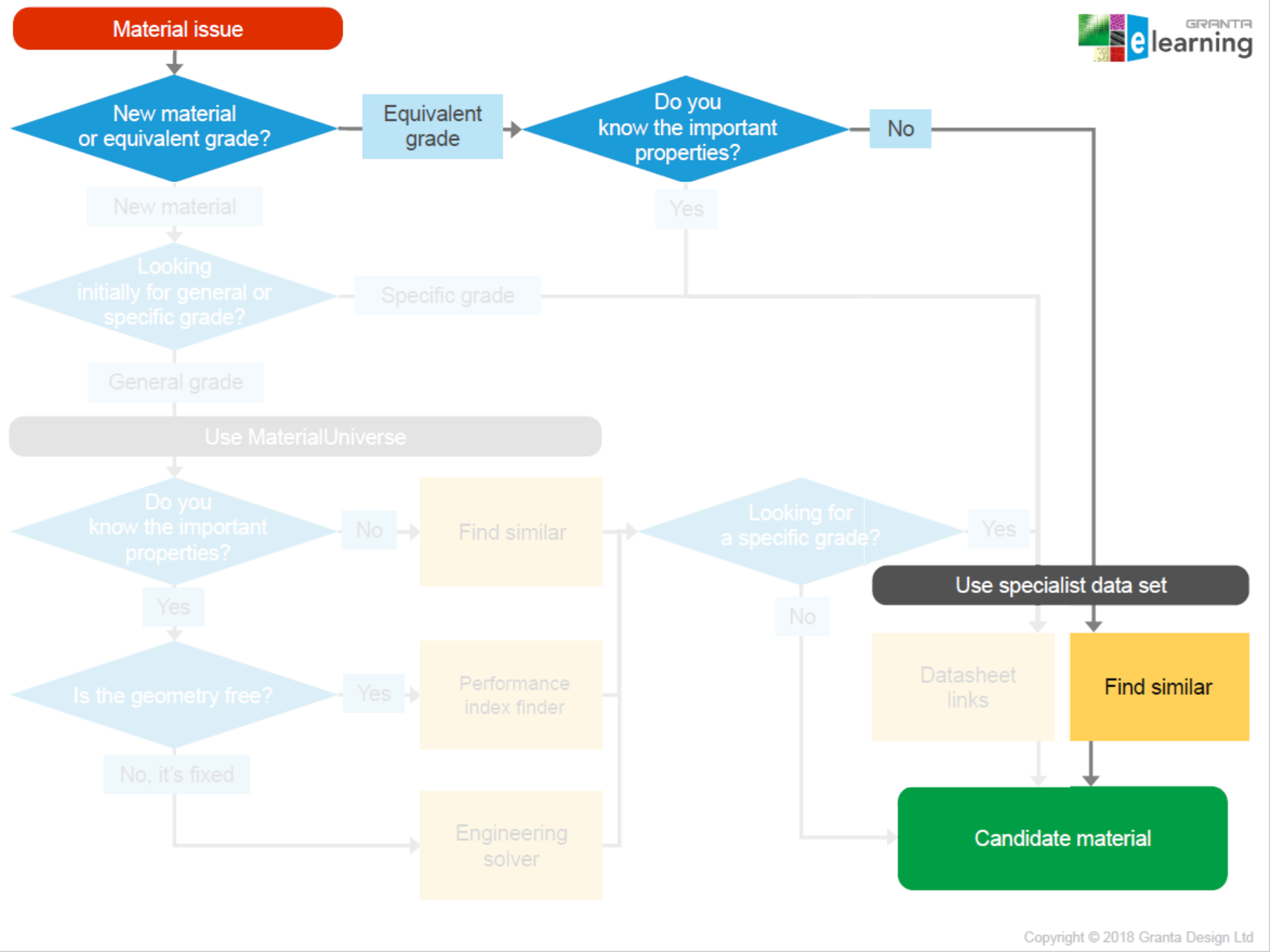
Important factors to consider

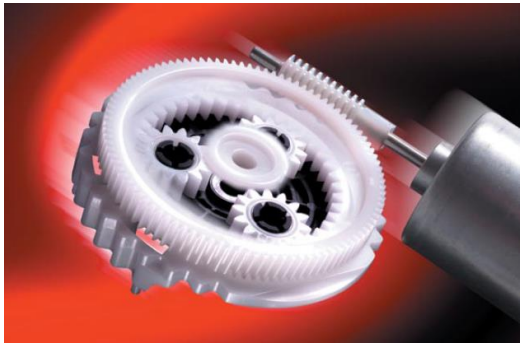
- Mechanical performance
- Use environment
- Processing
- Economics
- Environmental & end-of-life
- Regulatory / Compliance
- Company’s preferred materials & suppliers
- Flexibility to change design
- Transportation loads
- Installation & maintenance

Systematic selection methodology



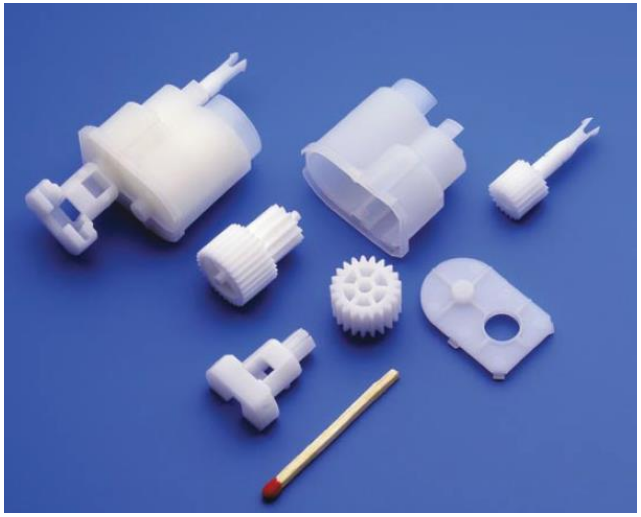




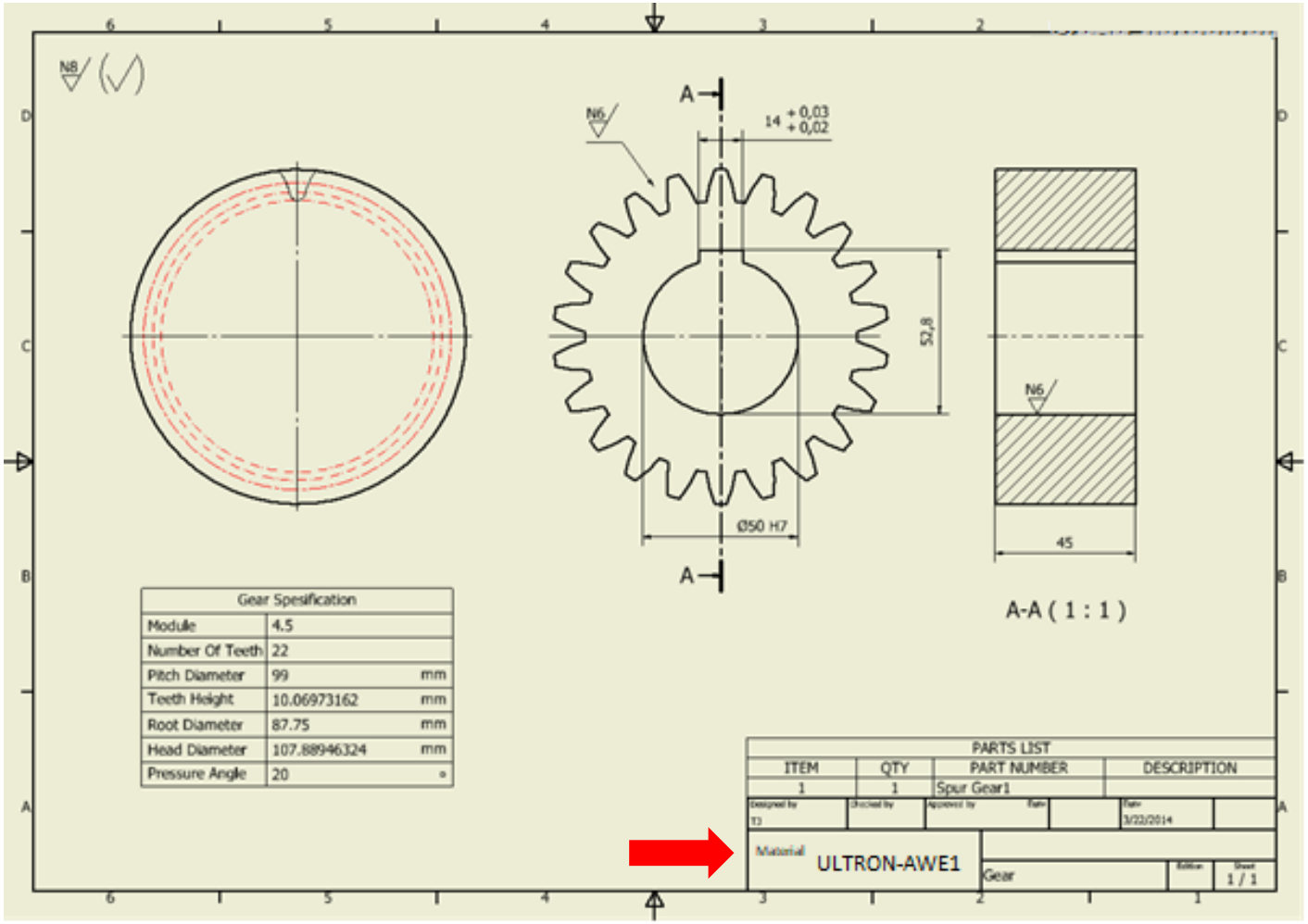


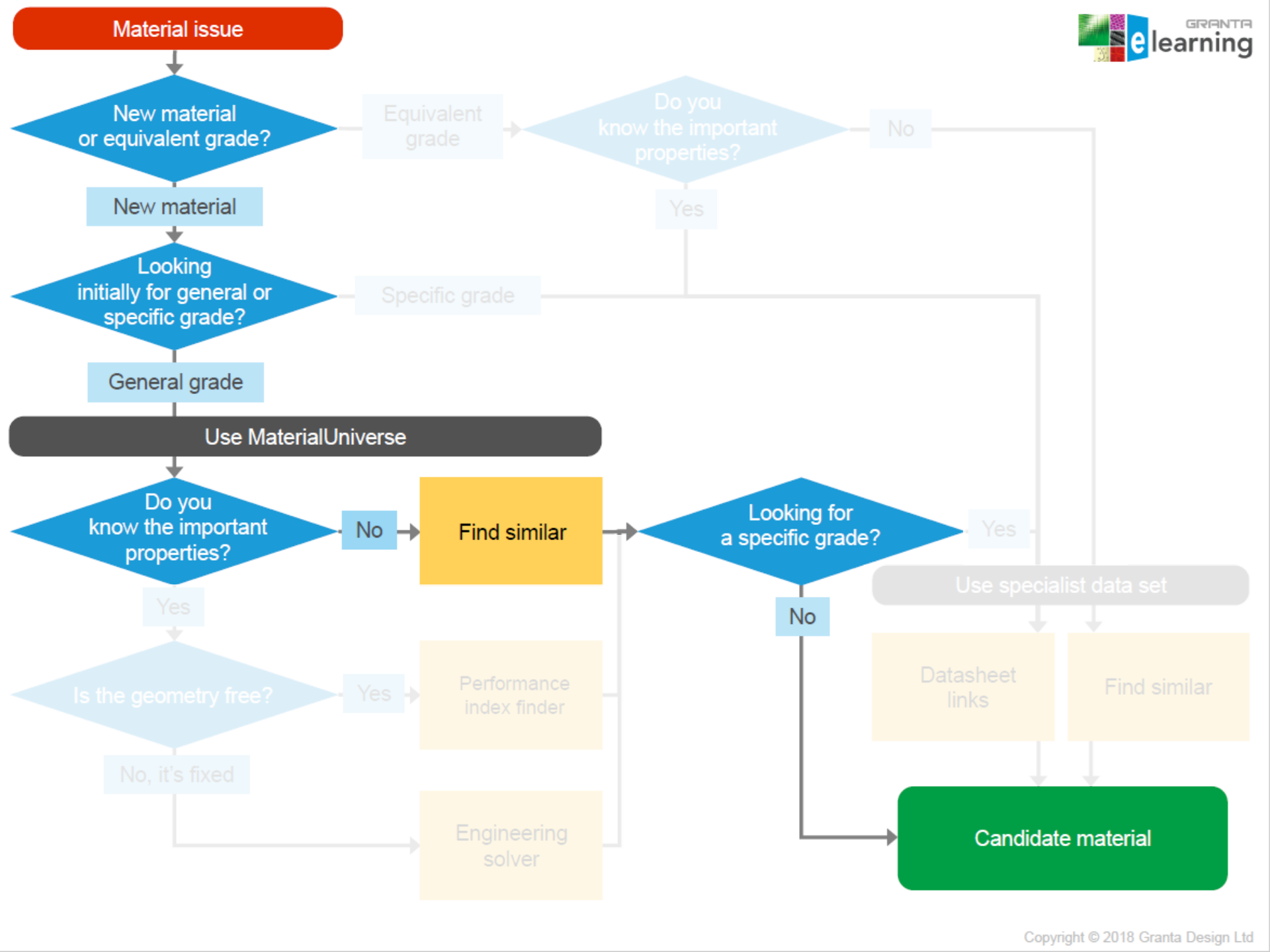
Example:

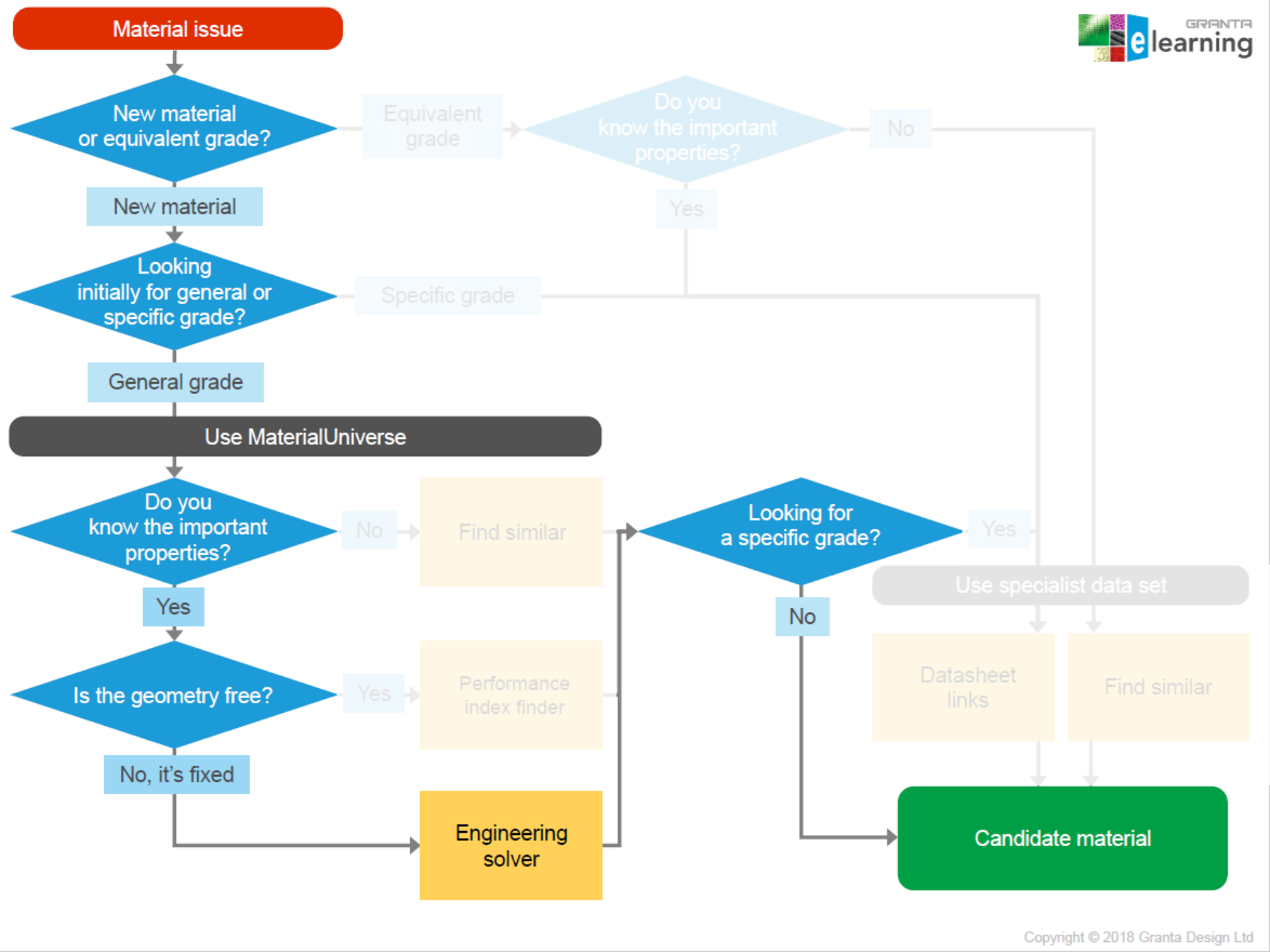
Polymer Gears



Polymer Gear – Design Requirements



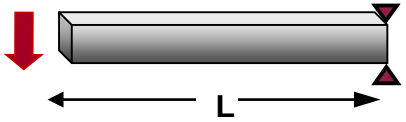




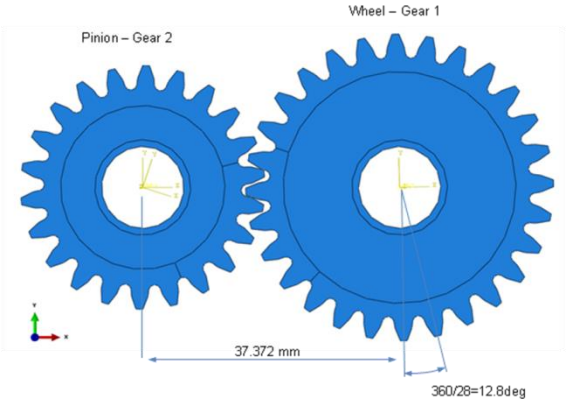
Unknown constraints

Function:

Gear wheel – transmit rotational motion, change speed, direction…



- Beam loaded in bending
- Strength-limited design
- Geometry fixed



Constraints:

- ?
- ?
- ?

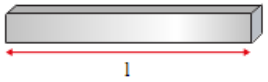
Objectives:

- Reduce chances of fracture
- Minimize cost

Engineering Solver

Engineering Solver

Beam in Bending Change situation



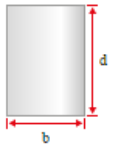
Estimates the minimum strength and stiffness values required for a beam with the specified geometry and load conditions.

Assumptions:

- Material is homogeneous and exhibits the same stiffness in tension & compression
- The beam is nominally straight, with uniform cross section
- Beam is long in proportion to its depth. Minimum length/depth ratio varies as follows:
  - Metal beams with compact section = 8
  - Beams with relatively thin webs = 15
  - Rectangular timber beams = 24

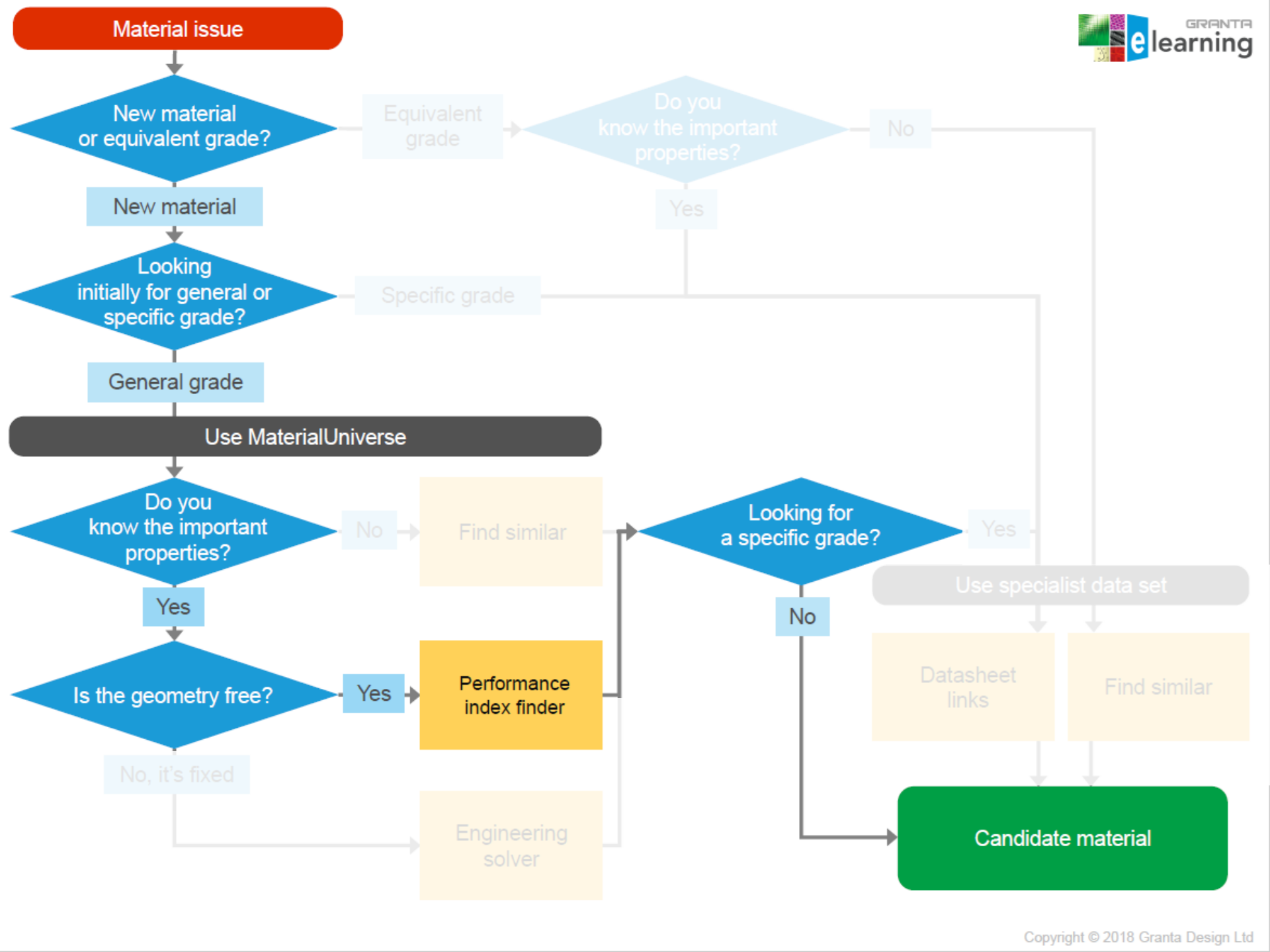
Geometry

Cross-section:	Rectangle ▼	
Breadth (b):	mm	
Depth (d):	mm	
Length (l):	m	

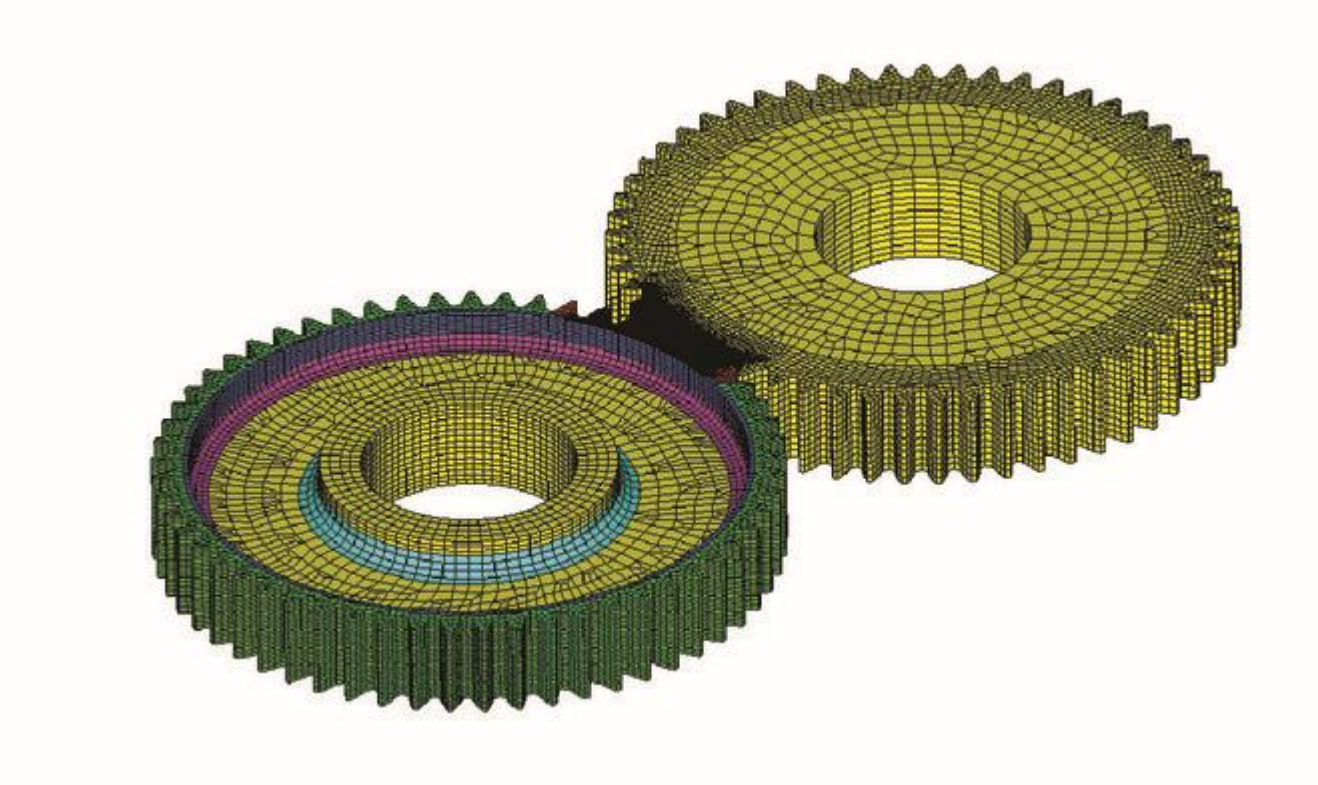


Design parameters

Load conditions:	Cantilever End load	
Load:	N	
Safety factor:	1	
Maximum deflection:	mm	



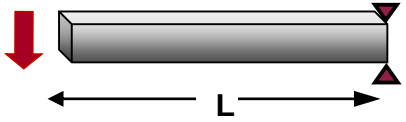
Optimizing performance



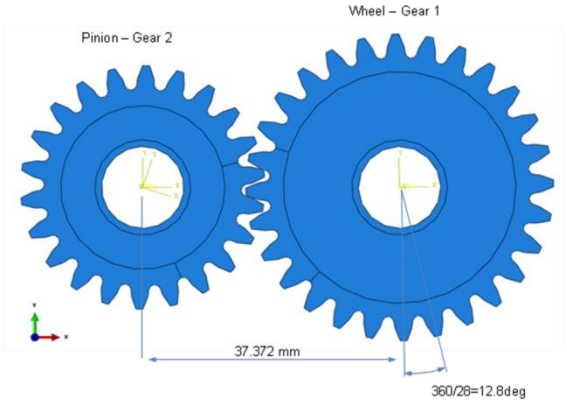
Optimizing Performance

Function:

Gear wheel – transmit rotational motion, change speed, direction…



- Beam loaded in bending
- Strength-limited design
- Geometry fixed



Constraints:

- High temperature resistance
- Good dimensional stability (to thermal load)
- Adequate toughness, stiffness, surface hardness
- Lubricated
- 3D complex shape

❖ **What values?**

Base on proposed material:

POM copolymer

Objectives:

- Extend life (wear / fatigue of teeth)
- Minimize cost

Summary

Approaches for defining design constraints

1) **Use experience of similar products & applications**
2) **Use CES Selector :**
    - Search databases for target application
    - Identify material grades used
    - Identify key features and characteristics
    - Specify constraints based on current / proposed material
3) **Key questions**
    - New material, replacement, or improvement?
    - Generic material or specific grade?
    - Are the design requirements already specified?
    - Is the geometry fixed?

GRANTA MATERIAL INTELLIGENCE

Training Schedule

Current schedule

DATE	TIME	DETAILS
Tue, 4th Sep 2018	3pm London 4pm CET (Paris, Berlin, etc.) 10am EST (New York) 7am PST (San Francisco)	Hints & tips on applying the systematic selection process in material selection studies
Nov 2018		*This is your training: let us know what topics you would like us to cover next!*

This is *your* training – please send us your feedback on:

- **Topics you'd like to cover**
- **Ideas/comments on the format of the sessions**
- **Feature requests or ideas for additional data coverage in CES**