Flexible Couplings

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CONTENTS

- Purpose of Coupling
- Types of Couplings
- Rigid Couplings
- Functions of Flexible coupling
- Types of Flexible Couplings
- Coupling selection chart
- Coupling balancing requirements

PURPOSE OF COUPLING

The coupling must be capable of

- Transmitting design torque.
- Operating at maximum continuous speed
- Handling speed and load transients
- Having minimum reactions on the drive system

TYPES OF COUPLINGS

- TYPES OF COUPLINGS:

1. Rigid Couplings
2. Flexible Couplings

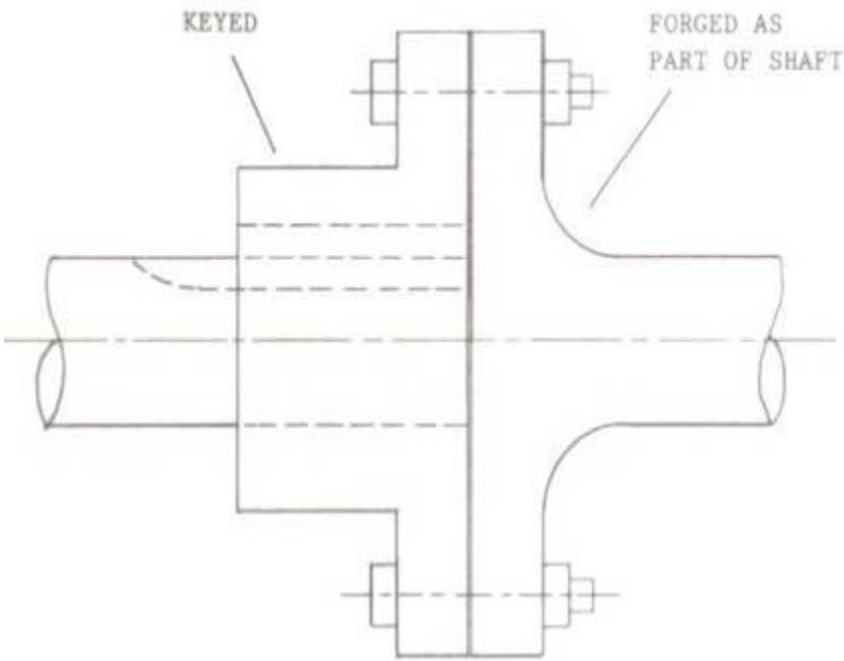
TYPES OF RIGID COUPLINGS:

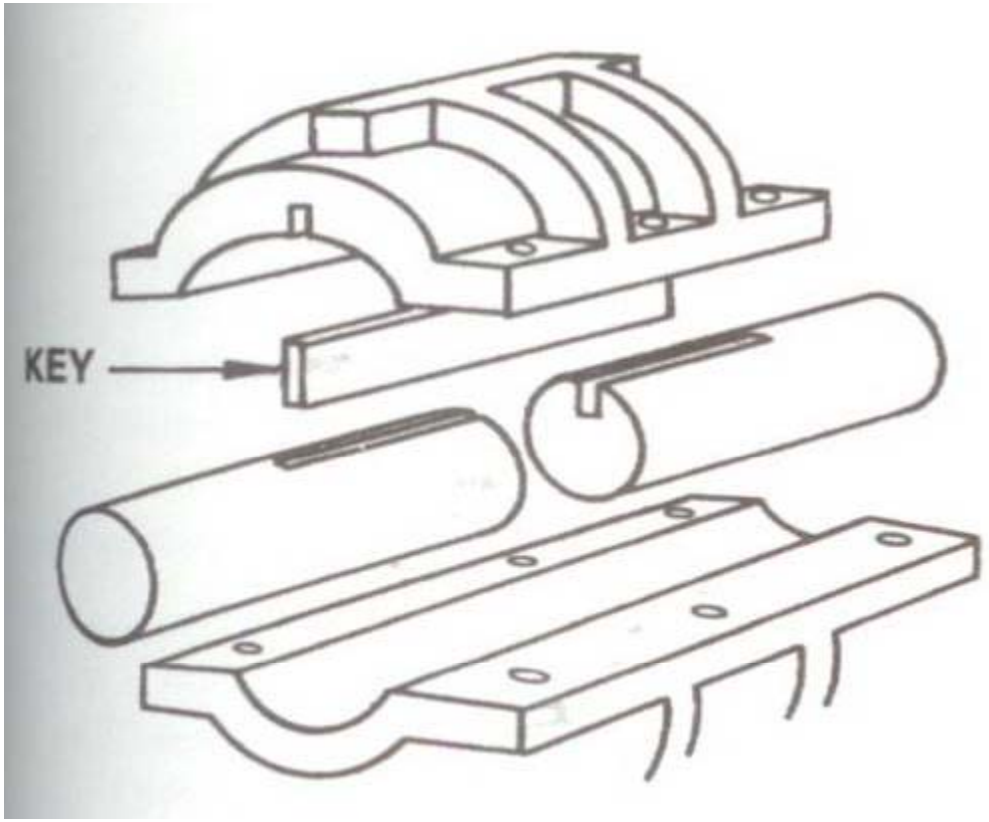
Rigid Cylinder:

- The cylinder can be solid , or ribbed.
- A key is always used that spans keyways machined in both shafts.

Rigid Flanges:

- Coupling halves are keyed onto the shafts, and then the flanges are bolted together.





FUNCTIONS OF FLEXIBLE COUPLINGS

- Following are the functions of a flexible coupling

1. Transmit Power
2. Accommodate misalignment
3. Allow axial displacement
4. Insure no loss of lubricants in grease packed couplings.

FUNCTIONS OF FLEXIBLE COUPLINGS

5. Easy to install and disassemble
6. Accept torsional shock and dampen torsional vibration
7. Stay rigidly attached to the shaft.
8. Withstand temperatures of environment or heat of friction

TYPES OF FLEXIBLE COUPLINGS

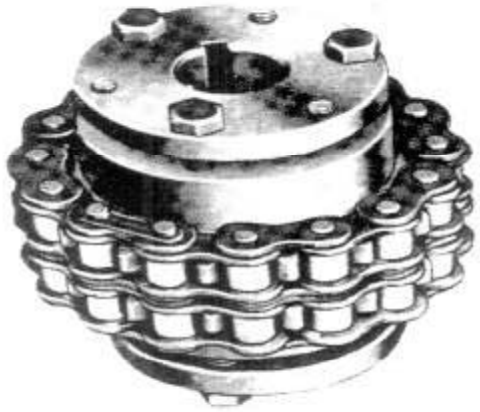
- TYPES OF FLEXIBLE COUPLINGS:

1. Mechanical Element
2. Elastomeric Element
3. Metallic Membrane / Disk Type

MECH ELEMENT COUPLING:

Chain Couplings:

- Two gear sprockets with hardened sprocket teeth connected by a double width chain
- Capacity : 3000 hp @ 1800 rpm
- Max Speed : up to 5000rpm



MECH ELEMENT COUPLING:

Chain Couplings:

Advantages:

- Easy to disassemble and reassemble
- Fewer number of parts

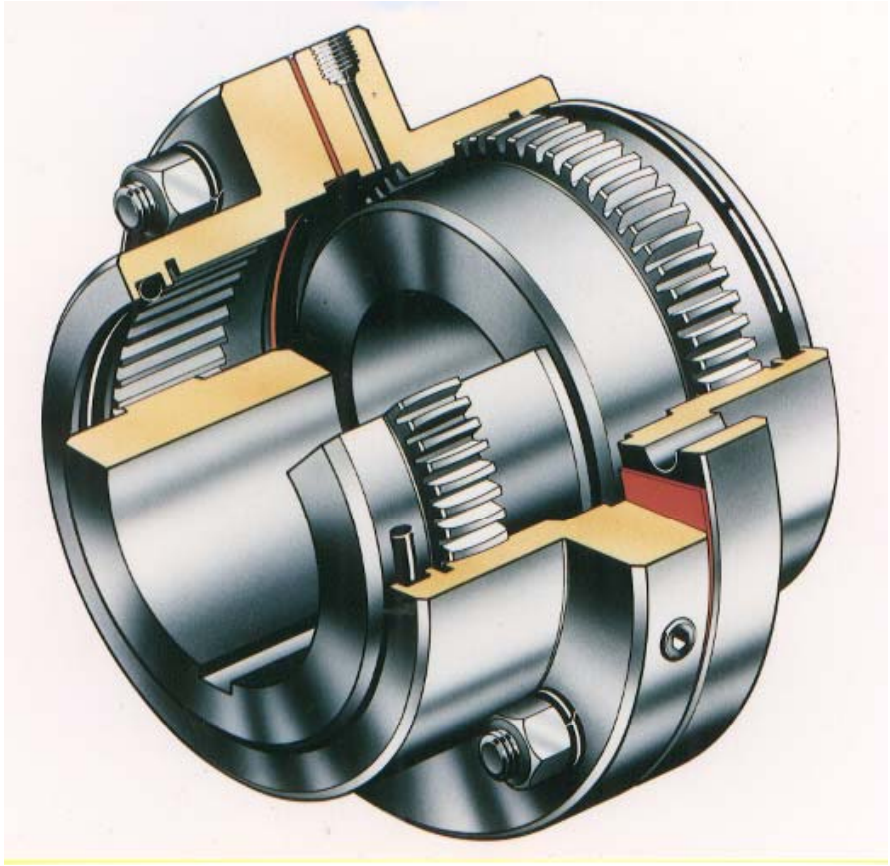
Disadvantages:

- Speed limited due to difficulties in maintaining balancing requirements
- Requires lubrication
- Limited allowable axial displacement

MECH ELEMENT COUPLING:

Gear Couplings:

- The gear coupling consists of two hubs with external gear teeth that are attached to the shaft
- A hub cover or sleeve with internal gear teeth engage with the shaft hubs to provide the transmission of power
- Lubrication of gear teeth is required.



MECH ELEMENT COUPLING:

Gear Couplings:

- Capacity : up to 70,000 hp
- Max Speed : up to 50,000rpm
- Backlash should be minimum and will be in accordance to the permissible misalignment
- Coupling assembly should have minimum 6mm of axial displacement
- Hardness of gear teeth<45Rc (Rockwell)
- Coupling guards should be air tight

MECH ELEMENT COUPLING:

Gear Couplings:

Torsional Tuning

- Shifting of one or more torsional natural frequencies of a coupled system to avoid system resonance at a known excitation
- Torsional tuning is accomplished by varying the torsional stiffness of the coupling

MECH ELEMENT COUPLING:

Gear Couplings:

Advantages:

- Allows freedom of axial movement
- Capable of operating at high speeds
- Low overhung weight
- Good balance characteristics.
- Long history of successful applications

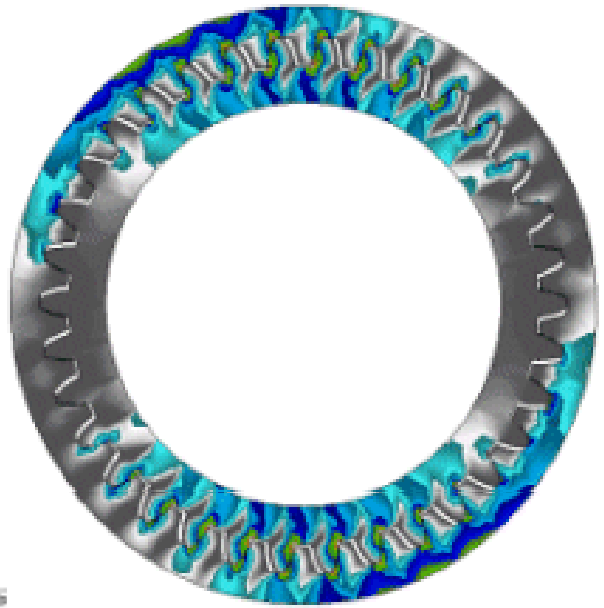
Disadvantages:

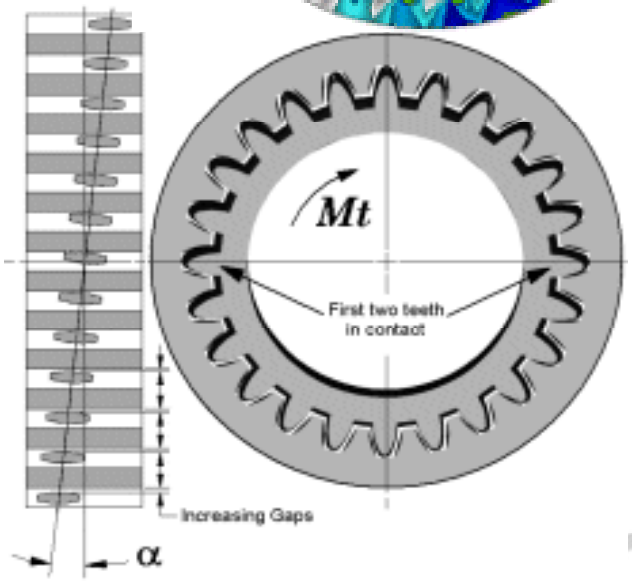
- Requires lubrication.
- Separation of greases into soaps and oils.
- Centrifugal effect on oils / sludge formation.
- Temperature limitation due to lubricant

MECH ELEMENT COUPLING:

Gear Couplings:

- There are only two teeth in contact when misalignment is present
- The remainder have a gap between each tooth set as shown in fig.
- In center of this picture the tooth is in pivoted position.
- At edges of this picture teeth are in ‘tilted’ position.
- 2-D FEA model at 0” misalignment.
- 2-D FEA model at 2” misalignment.





METALLIC ELEMENT COUPLING:

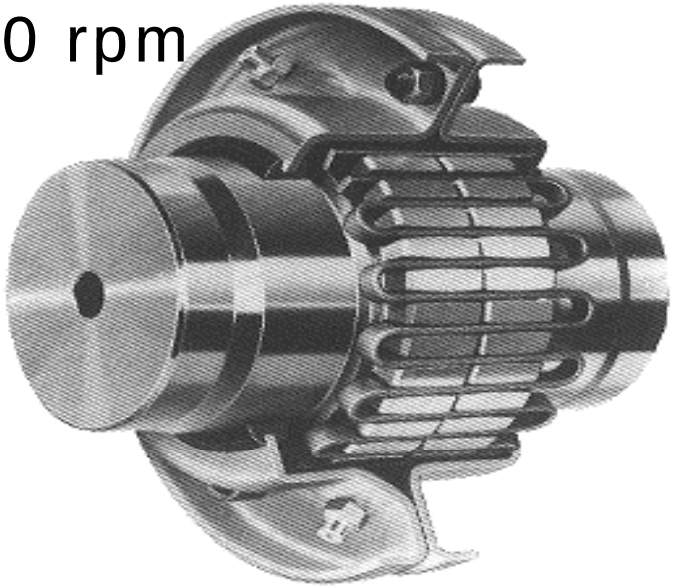
Metal Ribbon Couplings:

- Consist of two hubs with axial ‘grooves’ on the outer diameter of the hub
- A continuous ‘S’ shaped grid meshes into the grooves.
- Misalignment and axial movement is achieved by flexing and sliding of the grid member
- Lubrication of gear teeth is required.

MECH ELEMENT COUPLING:

Metal Ribbon Couplings:

- Grid is fabricated from hardened, high strength steel.
- Capacity : up to 70,000 hp / 100 rpm
- Max Speed : to 6000rpm



MECH ELEMENT COUPLING:

Metal Ribbon Couplings:

Advantages:

- Easy to assemble and disassemble.
- Long history of successful applications.
- Torsionally soft.

Disadvantages:

- Requires lubrication.
- Temperature limited.
- Speed limited

MECH ELEMENT COUPLING:

Flexible Link Coupling

- The flexible link coupling utilizes a series of cross laced, metallic links with one end of each link attached to a disc mounted on the driver shaft, and the other end of each link attached to a disc mounted on the driver shaft.
- The links are matched in pairs so that when one is in tension, the other is in compression.
- Misalignment and axial displacement is accomplished by a flexing action in the series of cross links.

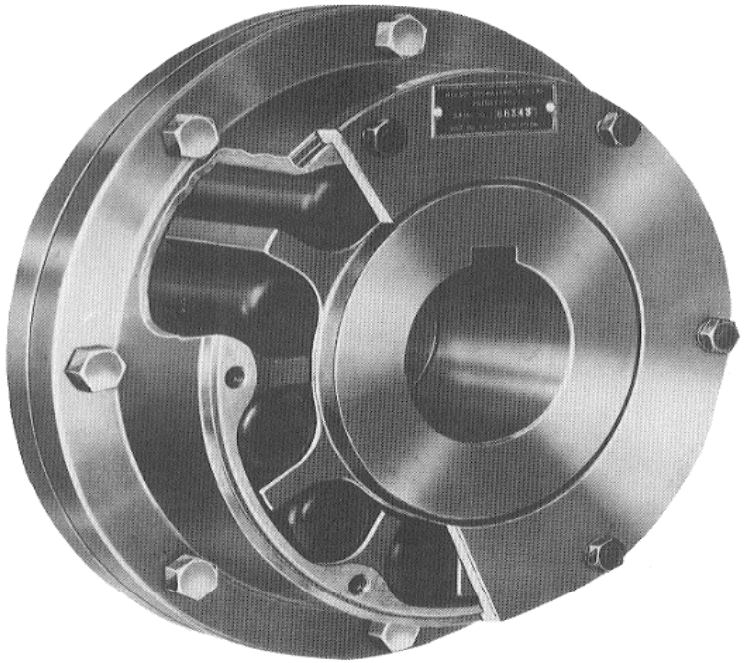
MECH ELEMENT COUPLING:

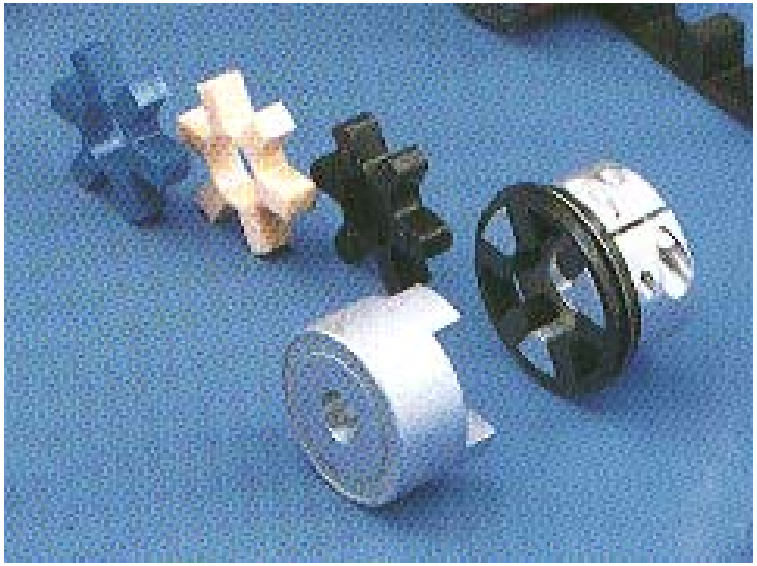
- Capacity : up to 30,000 hp
- Max Speed : up to 30,000rpm
- Shaft Bores : up to 7 in.
- Shaft Spacing: 2 to 200 in.

ELASTOMERIC COUPLING:

Elastomeric Compression:

- An elastomeric medium used to transmit torque and accommodate misalignment.
- Torsionally ‘soft’ to absorb high starting torques.
- The spider is generally natural or synthetic rubber, urethane, nylon and teflon.
- Capacity : up to 67,000 hp / 100 rpm
- Max Speed : approx. 5000rpm





ELASTOMERIC COUPLING:

Elastomeric Compression:

Advantages:

- Minimal wear in coupling.
- Act as vibration damper and isolator.
- Acts as electrical shaft current insulator.
- Torsionally soft.
- Allows axial movement and dampens axial vibration.
- No lubrication required.

Disadvantages:

- Speed limited (Cannot be balanced perfectly).
- Temp, oxidation of rubber and corrosive attack.
- Undesirable axial forces.
- Heat generation due to cyclic flexing.

ELASTOMERIC COUPLING:

Elastomeric Compression:

Failure modes:

- Abrasion: Rubber is a high friction material, and minor dust is produced.
- Temperature deformation:
- Rubber aging (drying):
- Consumption: Rubber and plastic are organic materials, and there are some creatures that eat them

ELASTOMERIC COUPLING:

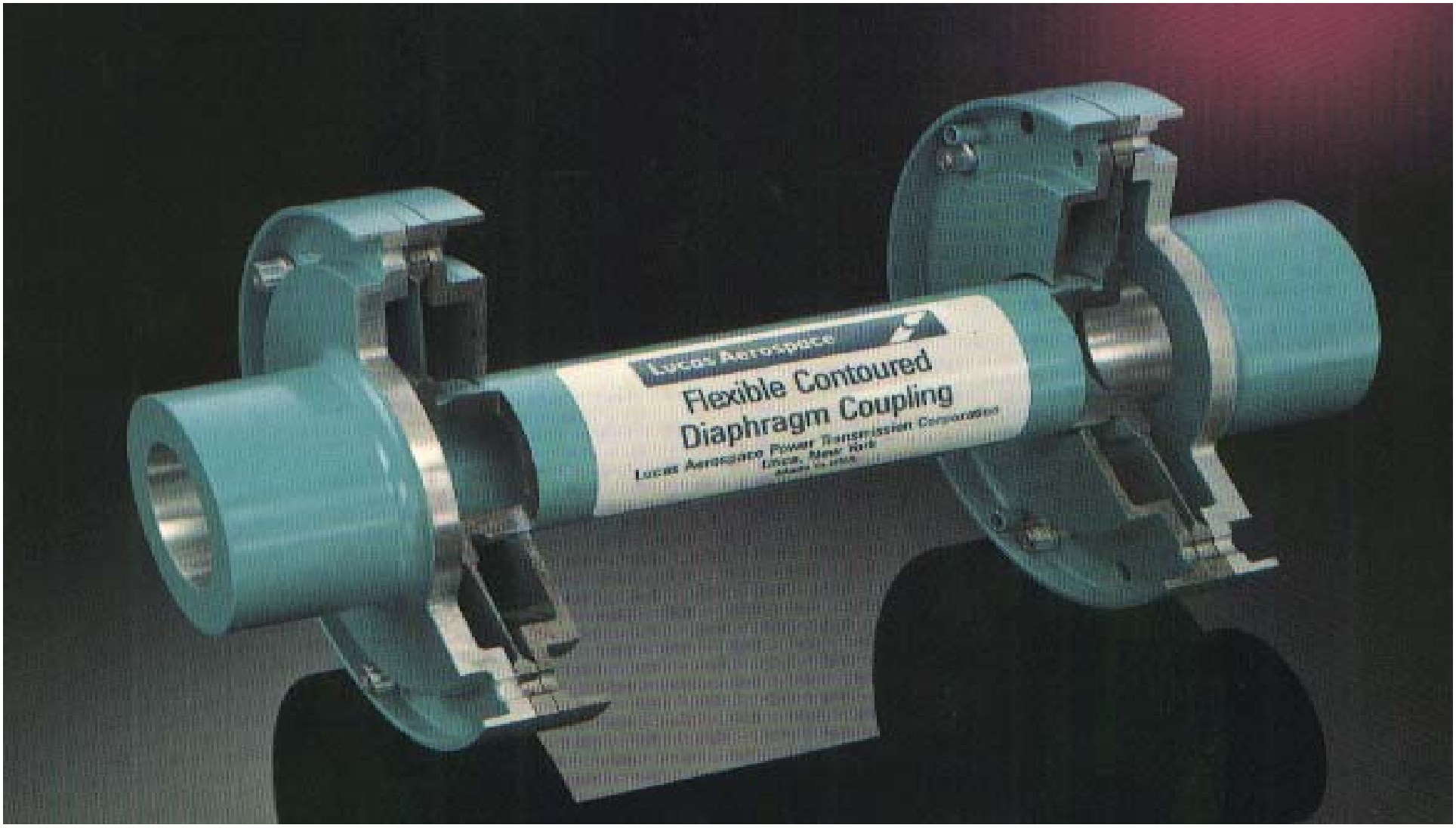
Elastomeric shear:

1. Toothed shear: It is easy to install and maintain, and handle large misalignment.
2. Tire type: Tire beads are clamped to a hub on either side. Torque is transmitted by the tire in shear.
3. Friction Disk: A rubber or suitable plastic bonded to a steel disk is pressed against another disk.

METALLIC MEMBRANE / DISK TYPE:

Diaphragm Couplings:

- Transmission of power through two flexible metal diaphragms.
- Bolted to the outer rim of the shaft hubs and connected via a spacer tube.
- Misalignment and axial displacement is absorbed by flexing of the diaphragm members.



METALLIC MEMBRANE / DISK TYPE:

Diaphragm Couplings:

- Diaphragm has an effect of a spring
- Coupling natural frequency does not match rotating speeds or harmonics in the drive system.
- Frequently used at gas turbines and compressors.
- Capacity : up to 30,000 hp
- Max Speed : to 100,000rpm (only coupling)

METALLIC MEMBRANE / DISK TYPE:

Diaphragm Couplings:

Advantages:

- Excellent balance characteristics.
- No lubrication required.
- Low coupling weight and bending forces.
- Accepts high temperature environment.

Disadvantages:

- Limited axial displacements and oscillation.
- Proper shaft spacing requirements.
- Excessive misalignment will transmit high loads to shafting.

METALLIC MEMBRANE / DISK TYPE:

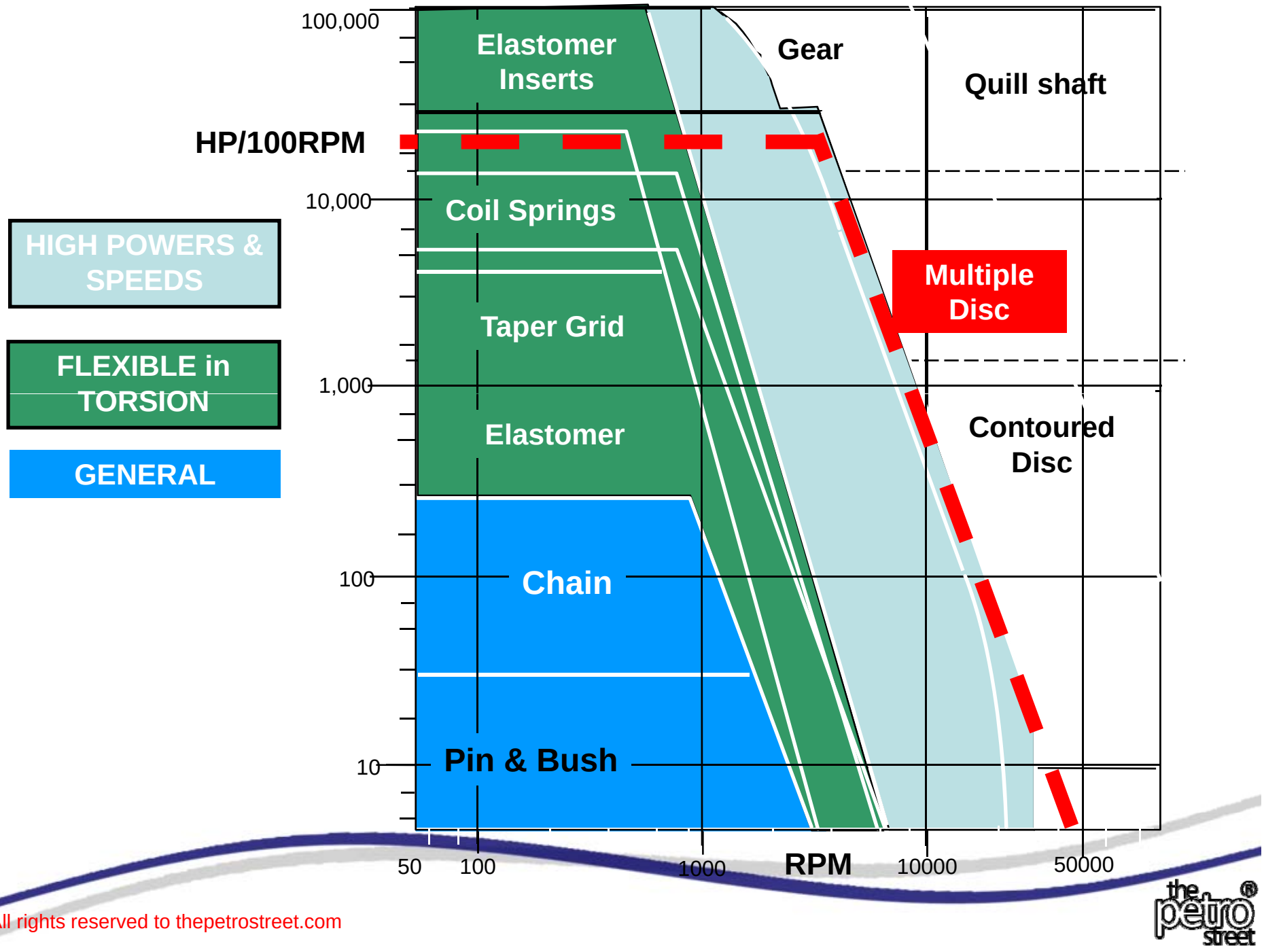
Flexible Disc Couplings

- The flexible disk coupling is very similar to the diaphragm coupling
- Multiple, thinner discs are used as the flexing element instead of circular, contoured diaphragm elements.
- Two disc packs (or diaphragms) are needed to accommodate parallel misalignment.
- A single disc can only handle pure angular misalignment.

METALLIC MEMBRANE / DISK TYPE:

Flexible Disc Couplings

- Capacity : up to 65,000 hp / 100 rpm
- Max Speed : up to 30,000rpm



Coupling Balancing Requirements

AGMA Coupling Balance Class	Maximum Potential Displacement (rss Microinches)
4	Over 32,000
5	32,000
6	16,000
7	8,000
8	4,000
9	2,000
10	1,000
11	500

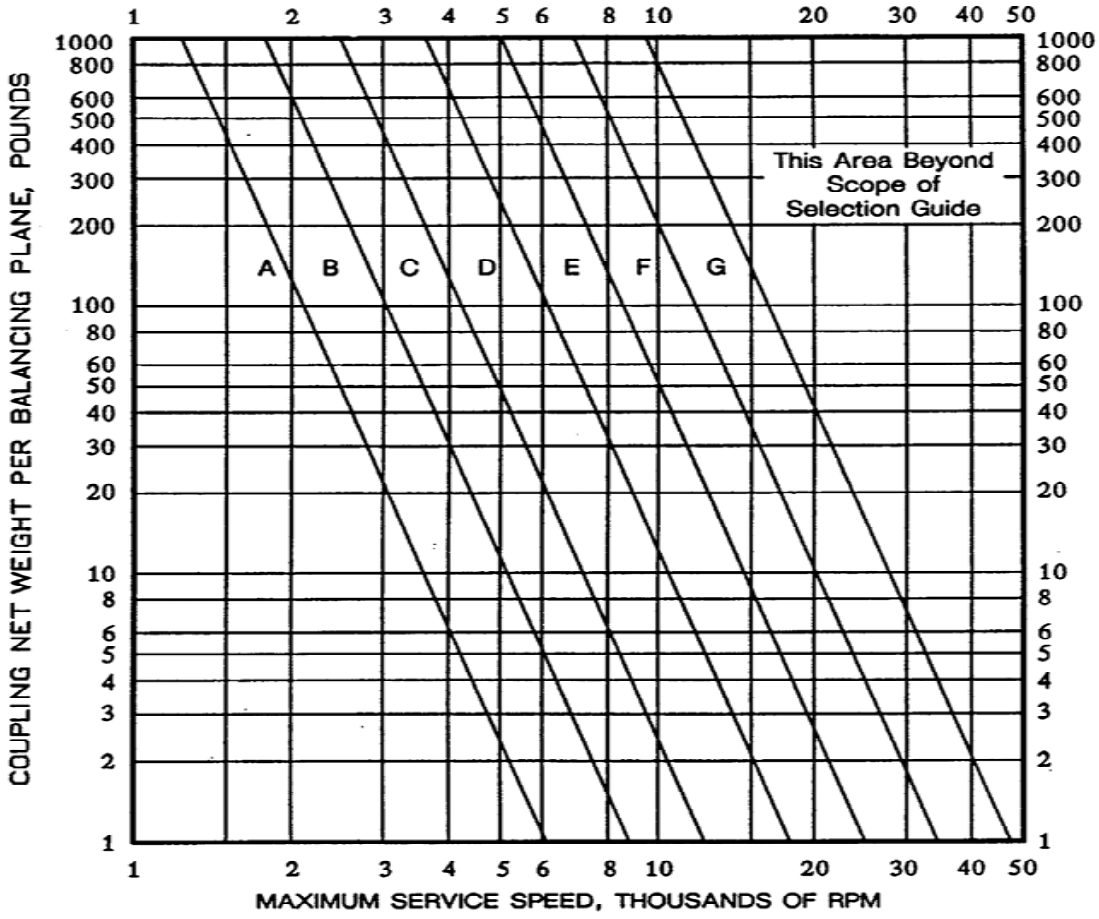


Table 5–1
Values of Coupling Balance Class

Selection Bands (From Fig 5–1)	System Sensitivity to Coupling Unbalance		
	Low	Average	High
A	5	6	7
B	6	7	8
C	7	8	9
D	8	9	10
E	9	10	11
F	10	11	
G	11		

NOTE: Refer to Table 4–1 for standard classes of coupling balance.

THANKS

- thePetroStreet team