



Turbo & EGR Platforms & Beyond

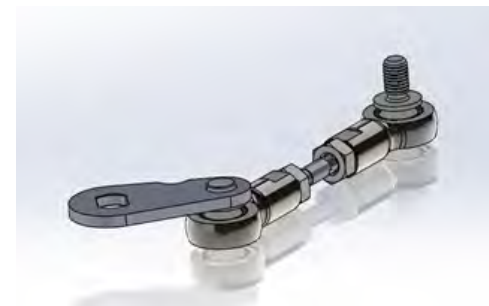
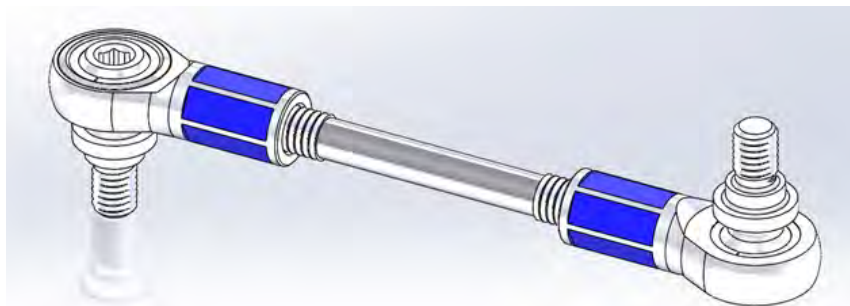
Prepared by: **Chris Kaufman**
Director of Engineering

Standard Cablecraft[®] Linkage Design:

- Based on "6mm – 1/4" Rod End family
- * Interchangeable Raceway
 (3 temperature ranges – See appendix)
 Natural Black (**MGT**), Blue Paint ID (**UHT**), White Paint ID (**HGT**)
- Adjustable or fixed CL's for tamperproof designs
- Controlled breakaway torque
- Variable CL lengths
- Threaded or rivet studs for assembly
- Hex drive for threaded stud assembly



*** Custom
 Cablecraft[®]
 Race System
 Race
 Material**





Custom levers can be permanently fixed to the linkage ends to ease assembly to the actuator (input) shaft or Turbo/EGR (output) positioning shaft

Alternate stud alignments allow for flexible positioning of sensitive equipment



High Temp Cablecraft® Linkages are designed to handle high temp gradients to help push sensitive electronics or other components away from the heat source. Prolonging life and reducing expensive cooling systems.

Cablecraft® offers 3 Rod End Linkages systems that target different Temperature ranges:

MGT: Continuous Operating Temp 232°C (450°F)

UHT: Continuous Operating Temp 301°C (575°F)

HGT: Continuous Operating Temp 343°C (650°F)

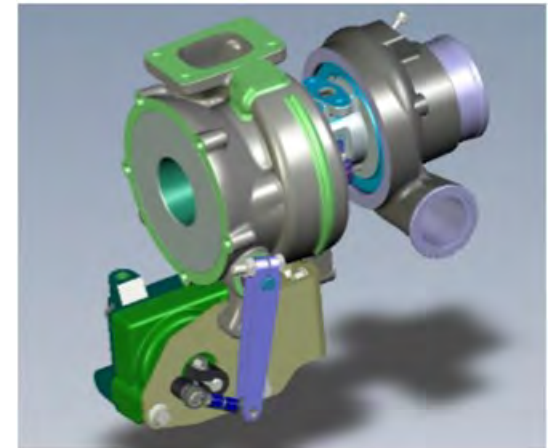
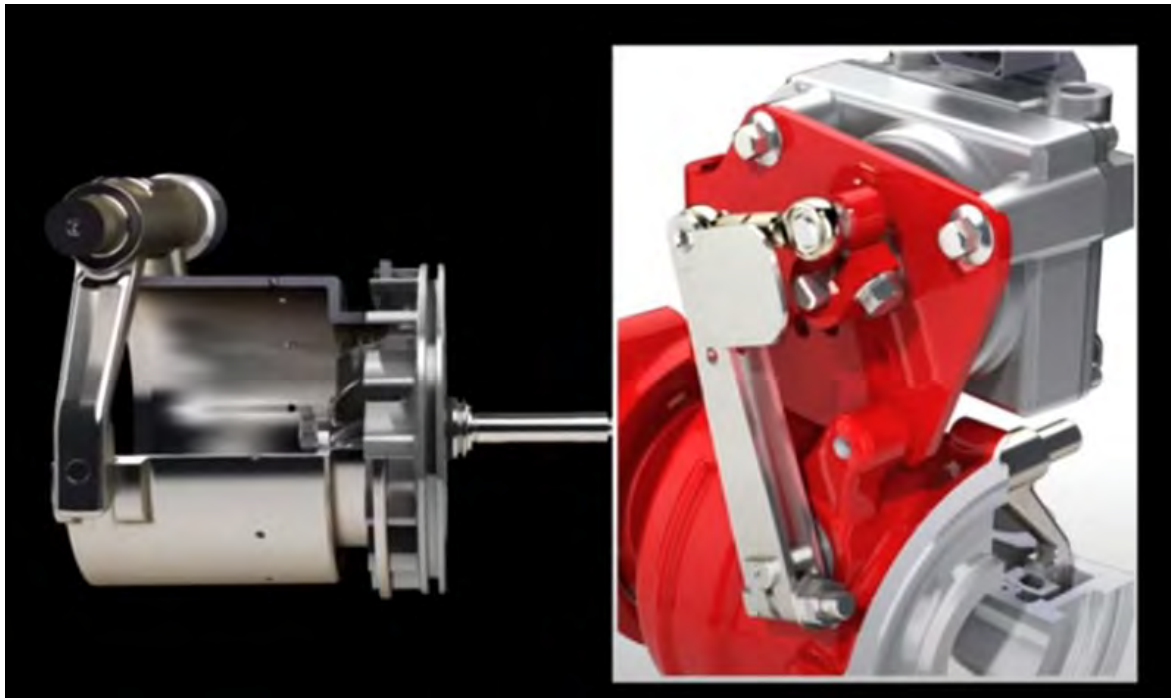


Performance Characteristics:

- Composite Raceways
 - Effectively dampen vibration of engine environments that cause excessive wear in metallic joints
 - Allow for low friction movement, while keeping play at minimum
 - No need for high cost stainless heat treatment or specialty coatings
 - Rod end design allows for misalignment and reduced cost in component location criticality
 - Also eliminates concerns of binding from temperature deflection in fixed pin designs that can't accommodate for misalignment
 - High strength material allows for high torque actuator usage
 - Raceway creates a clean seal on polished ball surface to help keep joint free of contaminants without needed external seals

On Application (example)

- Cablecraft's® flexible design allows for remote actuator placement



Where used?

Increased Fuel Economy & Performance

- On-highway diesel vehicles
- Farm/Construction equipment
- Hybrid vehicles – EGR valves
- Racing (turbo-chargers)
- Material handling equipment

High-Temp Applications

- Food equipment
- Industrial near heat source applications
- HVAC

Harsh Environments

- Chemical plants
- Power plants



Why Cablecraft®?

- Composite raceway's absorb **vibration** generation from the application preventing accelerated joint degradation
- **Lightweight** design lowers mass acceleration that can impact connected components
- Linkage centerline can be **custom length and alignment** per application without large tooling impact
- Detachable connection point makes electronic actuator or turbo **serviceable** without removing entire unit (At lever arm or ball stud of rod end)
- Composite raceway design allows for use of **standard high corrosion resistant steel** without the use of expensive coatings or Heat Treatment processes
- Composite raceway is **resistant to common engine compartment contaminants**
 - (Oil, Cleaners, fuel, corrosive liquids, etc. - For more details contact Cablecraft Engineering)
- Swivel rod end design allows for **non-parallel** alignment parallel of actuator shaft to output shaft (Turbo, etc.)
- **High strength in small package!** Typical min axial strength (250 lbs./1112N) and min radial strength of (1000 lbs./4448N) as tested in a typical linkage assembly

Web Appendix

MGT: Continuous Operating Temp 232°C (450°F)
Est. max. overtemp condition: 282°C (540°F)*

UHT: Continuous Operating Temp 301°C (575°F)
Est. max. overtemp condition: 349°C (660°F)*

HGT: Continuous Operating Temp 343°C (650°F)
Est. max. overtemp condition: 415°C (780°F)*

*TIME AT THIS TEMP IS TO BE LIMITED IN THE AMOUNT OF OCCURANCES (~ <0.5% OF TOTAL LIFE) AS WELL AS THE TIME OF EACH OCCURANCE.

THIS EXPOSURE NEEDS TO BE VALIDATED PER APPLICATION AND CAN BE LOAD SENSITIVE THUS REDUCING THE TIME ALLOWANCE.

CONSULTATION WITH THE CABLECRAFT[®] ENGINEERING TEAM IS RECOMMENDED.

Appendix

MGT: Continuous Operating Temp 232°C (450°F)

FORM E6:12-10


MID GRADE TEMPERATURE (M.G.T.) - CUSTOM CABLECRAFT RACEWAY

PART NUMBER MGT (DATA)

ASSOCIATED PART NUMBERS (* = PROD RELEASED):

HFM9000
 HFM9002 *
 HFM9003
 HFM9004

KEY DIMENSIONS (REF)			
PART NUMBER	SIZE CODE	INNER DIAMETER	RACE WIDTH
HFM9000	3	.375	.206
HFM9002	4	.437	.236
HFM9003	5	.550	.294
HFM9004	6	.675	.372



HIGH TEMP RACE IS CAPTURED IN STAINLESS STEEL HOUSING

NON-PROPRIETARY M.G.T. RACE PROPERTIES

TENSILE STRENGTH @ 23°C (74 °F) = 140 MPa
 275°C (527 °F) = 35 MPa

MELTING POINT = 343°C (650°F)

GLASS TRANSITION (T_g) = 143°C (289°F)

HEAT DEFLECTION TEMP @ 1.8 MPa (ISO 75-f) = 315°C (599°F)

TESTED WITH MINIMAL MECHANICAL DEGRADATION TO 232°C (450°F) CONTINUOUS OPERATION
 (VALIDATION INCLUDES SIZE 4 ONLY)

****CABLECRAFT PROPRIETARY TEST SPECIFICATION AVAILABLE UPON REQUEST****

ESTIMATED MAX OVERTEMP CONDITION 282°C (540°F) - TIME AT THIS TEMP IS TO BE LIMITED IN THE AMOUNT OF OCCURRENCES (~ <0.5% OF TOTAL LIFE) AS WELL AS THE TIME OF EACH OCCURRENCE. THIS NEEDS TO BE VALIDATED PER APPLICATION AND CAN BE LOAD SENSITIVE THUS REDUCING THE TIME ALLOWANCE

COLOR = BLACK (NATURAL)

CHEMICAL RESISTANCE - AVAILABLE UPON REQUEST FOR RAW MATERIAL REF ONLY

**** RACE AND ROD END SYSTEM IS PATENT PENDING**

Additional Notes:

- Typical stainless steel grade is 3XX series stainless
- Cablecraft[®] linkage assembly process and internal design parameters are proprietary and key to our superior performance over standard rod end designs

Appendix

UHT: Continuous Operating Temp 301°C (575°F)

FORM E6-12-10

ULTRA HIGH TEMPERATURE (U.H.T.) - CUSTOM CABLECRAFT RACEWAY

PART NUMBER
UHT (DATA)

ASSOCIATED PART NUMBERS (* = PROD RELEASED):

HFM9102
HFM9202 *
HFM9302
HFM9402

KEY DIMENSIONS (REF)			
PART NUMBER	SIZE CODE	INNER DIAMETER	RACE WIDTH
HFM9102	3	.375	.206
HFM9202	4	.437	.236
HFM9302	5	.550	.294
HFM9402	6	.675	.372

NON-PROPRIETARY U.H.T. RACE PROPERTIES

TENSILE STRENGTH @ 23°C (74 °F) = 270 MPa
275°C (527 °F) = 70 MPa

MELTING POINT = 387°C (728°F)

GLASS TRANSITION (T_g) = 162°C (323°F)

HEAT DEFLECTION TEMP @ 1.8 MPa (ISO 75-f) = 383°C (721°F)


TESTED WITH MINIMAL MECHANICAL DEGRADATION TO 301°C (575°F) CONTINUOUS OPERATION
(VALIDATION INCLUDES SIZE 4 ONLY)

****CABLECRAFT PROPRIETARY TEST SPECIFICATION AVAILABLE UPON REQUEST****

ESTIMATED MAX OVERTEMP CONDITION 349°C (660°F) - TIME AT THIS TEMP IS TO BE LIMITED IN THE AMOUNT OF OCCURRANCES (~ <0.5% OF TOTAL LIFE) AS WELL AS THE TIME OF EACH OCCURRANCE. THIS NEEDS TO BE VALIDATED PER APPLICATION AND CAN BE LOAD SENSITIVE THUS REDUCING THE TIME ALLOWANCE

COLOR = BLACK (FACE PAINTED BLUE FOR ID PURPOSES ONLY)

CHEMICAL RESISTANCE - AVAILABLE UPON REQUEST FOR RAW MATERIAL REF ONLY



HIGH TEMP RACE IS CAPTURED IN STAINLESS STEEL HOUSING

FACE OF RACE IS MARKED BLUE

**** RACE AND ROD END SYSTEM IS PATENT PENDING**

Additional Notes:

- Typical stainless steel grade is 3XX series stainless
- Cablecraft[®] linkage assembly process and internal design parameters are proprietary and key to our superior performance over standard rod end designs

Appendix

HGT: Continuous Operating Temp 343°C (650°F)

FORM E6:12-10

HIGH GRADE TEMPERATURE (H.G.T.) - CUSTOM CABLECRAFT RACEWAY

PART NUMBER
HGT (DATA)

ASSOCIATED PART NUMBERS (* = PROD RELEASED):

HFM9101
 HFM9201 *
 HFM9301
 HFM9401

KEY DIMENSIONS (REF)			
PART NUMBER	SIZE CODE	INNER DIAMETER	RACE WIDTH
HFM9101	3	.375	.206
HFM9201	4	.437	.236
HFM9301	5	.550	.294
HFM9401	6	.675	.372

NON-PROPRIETARY H.G.T. RACE PROPERTIES

TENSILE STRENGTH @ 23°C (74 °F) = 124 MPa
 260°C (500 °F) = 55 MPa


MELTING POINT = NONE

TESTED WITH MINIMAL MECHANICAL DEGRADATION TO 343°C (650°F) CONTINUOUS OPERATION
 (VALIDATION INCLUDES SIZE 4 ONLY)
****CABLECRAFT PROPRIETARY TEST SPECIFICATION AVAILABLE UPON REQUEST****

ESTIMATED MAX OVERTEMP CONDITION: 415°C (780°F) - TIME AT THIS TEMP IS TO BE LIMITED IN THE AMOUNT OF OCCURRENCES (~ <0.5% OF TOTAL LIFE) AS WELL AS THE TIME OF EACH OCCURRENCE. THIS NEEDS TO BE VALIDATED PER APPLICATION AND CAN BE LOAD SENSITIVE THUS REDUCING THE TIME ALLOWANCE.

COLOR = BLACK (FACE PAINTED WHITE FOR ID PURPOSED ONLY)

CHEMICAL RESISTANCE - AVAILABLE UPON REQUEST FOR RAW MATERIAL REF ONLY



HIGH TEMP RACE IS CAPTURED IN STAINLESS STEEL HOUSING

FACE OF RACE IS MARKED WHITE

**** RACE AND ROD END SYSTEM IS PATENT PENDING**

Additional Notes:

- Typical stainless steel grade is 3XX series stainless
- Cablecraft[®] linkage assembly process and internal design parameters are proprietary and key to our superior performance over standard rod end designs
- Cablecraft[®] type HGT raceway does NOT have a melt temperature, but prolonged temps over the recommended limits in a specific application can degrade the performance. Consult with the Cablecraft[®] engineering team for more details.