



# Lubricants for the Steel Industry

**The webinar will begin in less than 10 minutes.**

David Turner, CLS, OMA-I, CLGS



# Lubricants for the Steel Industry

**The webinar will begin in less than 5 minutes.**

David Turner, CLS, OMA-I, CLGS



# Lubricants for the Steel Industry

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## David Turner

- CITGO Sr. Technical Services Representative
- BS, Chemical Engineering
- 39+ Years Experience in Lubricants
- STLE Certified
  - Certified Lubrication Specialist
  - Oil Monitoring Analyst I
- NLGI Certified
  - Certified Lubricating Grease Specialist
- Active in STLE, NLGI, and ASTM



## Agenda

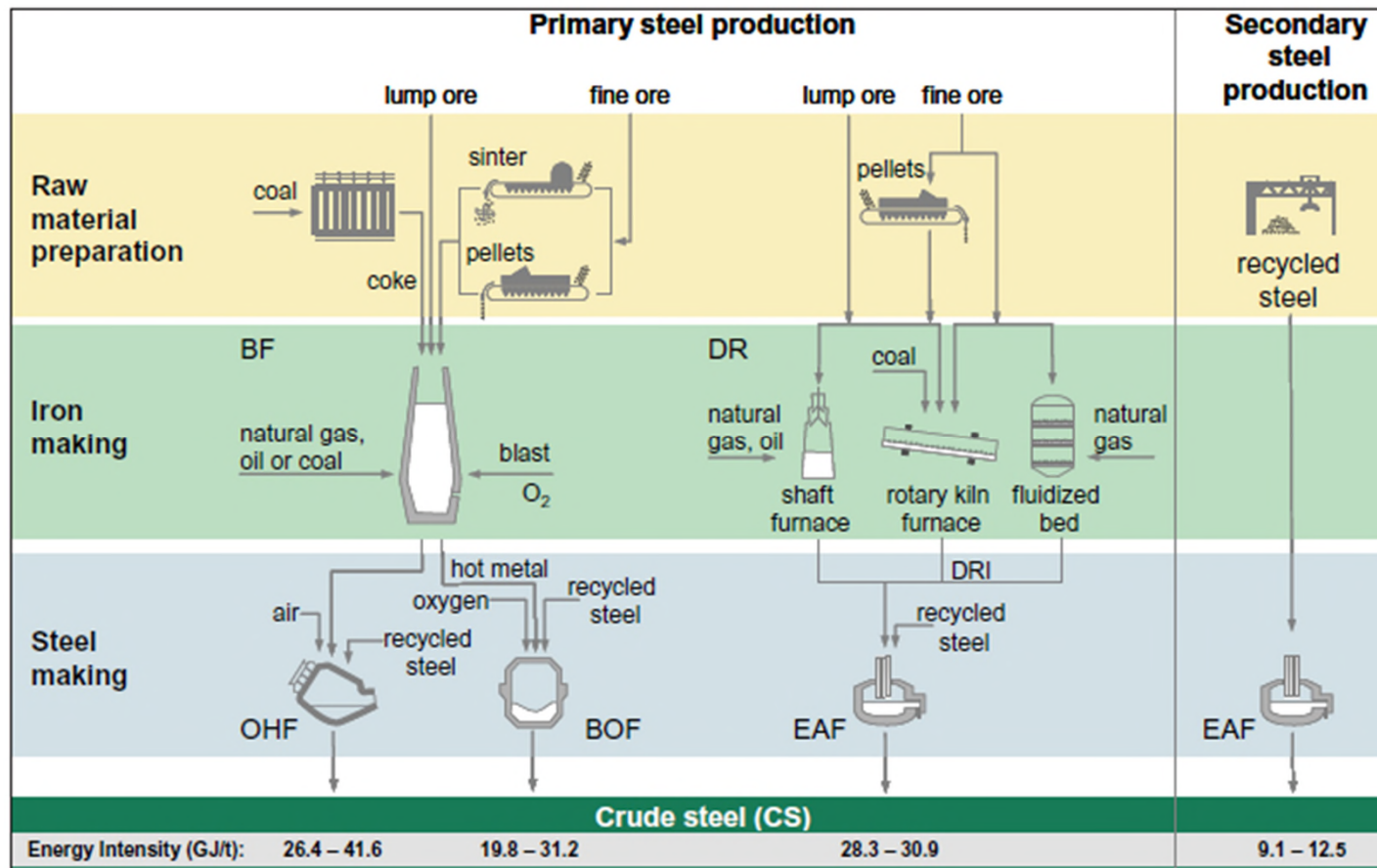
- Steelmaking Process
- Basic Parts of a Steel Mill
- CITGO Lubricants for Steel Mill Applications



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# Steelmaking Process

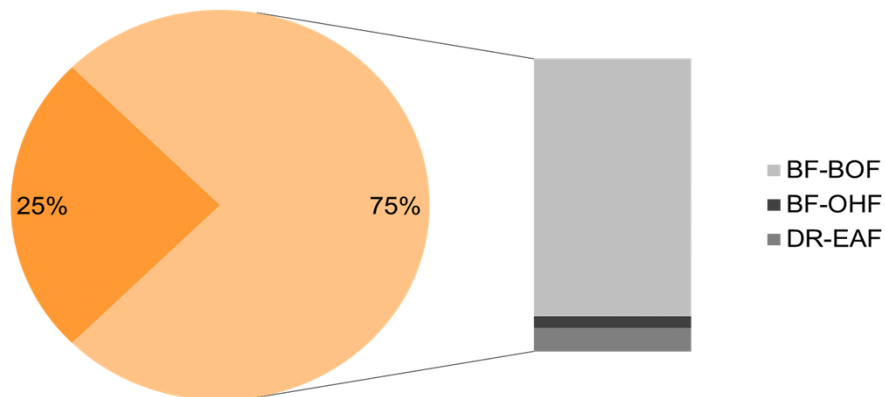
# Primary and Secondary Steelmaking Processes



Source: Worldsteel

## Primary vs. Secondary Production

- Secondary production consumes less energy
- Less capital is required for startup
- Most steel products remain in use for decades before being recycled
- Recycled steel supply is not enough for secondary production to meet demand alone



75% Primary, 25% Secondary

BF-BOF: Blast Furnace, Basic Oxygen Furnace  
BF-OHF: Blast Furnace, Open Hearth Furnace (use is in decline due to environmental and economic disadvantages)  
DR-EAF: Direct Reduction, Electric Arc Furnace  
Secondary Production uses EAF



# Steelmaking

## Basic Oxygen Steelmaking (BOS, BOF)

- Pig iron (high carbon), along with some steel scrap, is blown with oxygen to reduce carbon content. Alloying elements are added as needed to produce specific steel grades.

## Electric Arc Furnace (EAF)

- Mainly steel scrap is heated with an electric arc to melt. Composition can be adjusted by the addition of alloying elements.

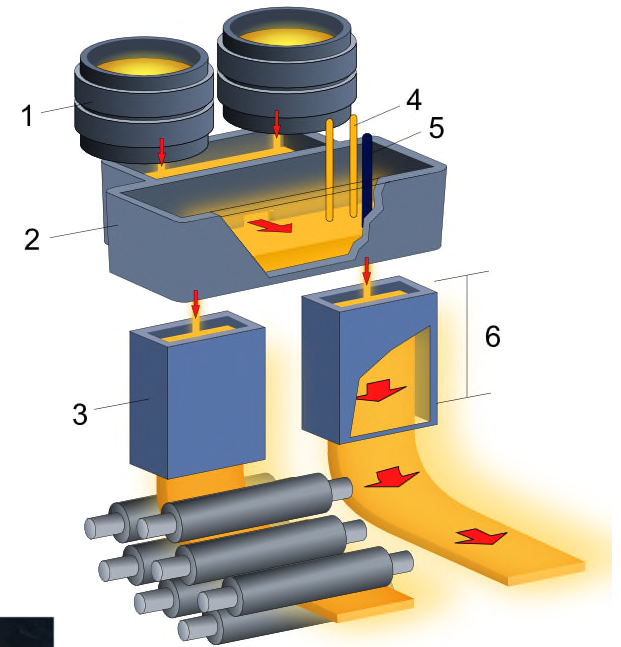
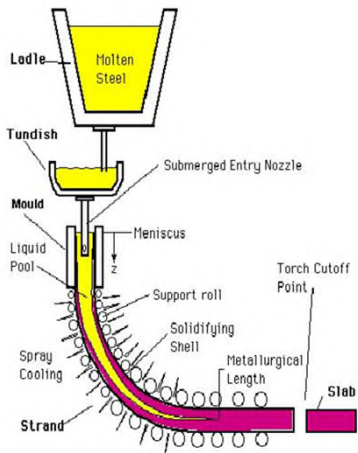


By Jschnalzer at English Wikipedia, CC BY 2.5,  
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# Continuous Casting

Molten steel from a ladle is fed into a continuous casting machine. The molten metal is poured through a mold that forms ingots, blooms, billets, or slabs.



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Graphics Source: Metsoc.org, The Metallurgy and Materials Society Metallurgists, and U. S. Steel Corp.

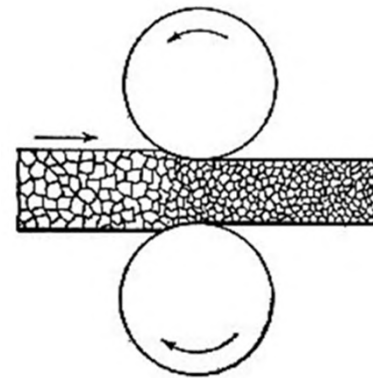
# Rolling Mill

## Hot Rolling

- A billet, bloom, ingot, or slab is heated in a reheat furnace, then fed into a series of rollers that reduce the size and increase the length. Various shapes – rebar, angle iron, channel iron, I-beam, etc. – can be produced in this way.

## Cold Rolling

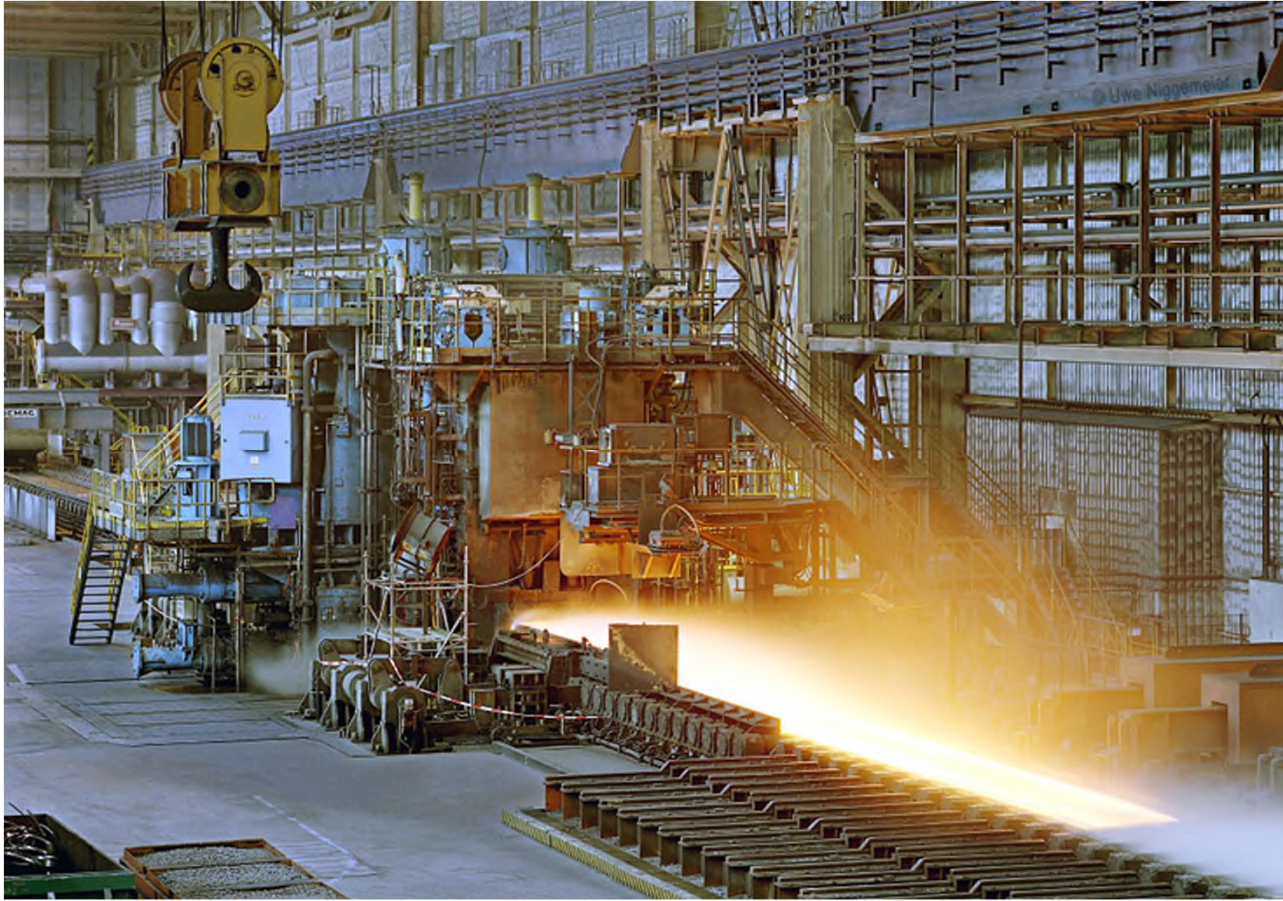
- Sheets of steel are rolled at or near room temperature to produce a thinner cross section and often a specific shape.



By Schmimi1848 - Own work, CC BY-SA 3.0,  
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# Hot Strip Mill



## Hot Rolling

### Plain

- Strip for flat products such as cladding



### Profiled

- Beams, columns, etc. used in construction





## Mill Types

- Primary Breakdown Mills
- Plate Mills
- Bar and Billet Mills
- Rod Mills
- Seamless Steel Tube Mills
- Pipe Mills
- Structural and Rail Mills
- Hot Strip Mills
- Cold Rolling Tandem Mills
- Twin Double Stand Reduction Mills
- Single/Two Stand Mills

Source: "Steel Industry" A.E. Cichelli, CRC Handbook of Lubrication Volume I

# Basic Parts of a Steel Mill

## Coke Plant

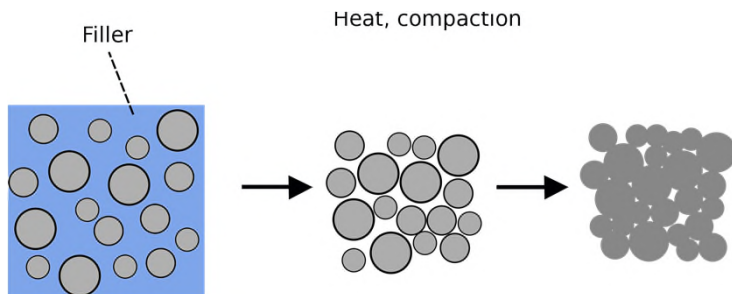
Coke is produced by the heating of coal in the absence of air/oxygen. The product is a hard, gray, porous material with a very high carbon content and very few impurities. Coke is used in the smelting of iron ore to produce iron that is suitable for the manufacture of steel. The product is often referred to as pig iron.





## Sinter Plant

Sintering is the process of agglomerating iron ore fines into nodules of material that are suitable for use in a blast furnace. The process of sintering recovers fine material that cannot be fed into the furnace as-is, reducing waste and possible pollutants, and improving the economics of steelmaking.



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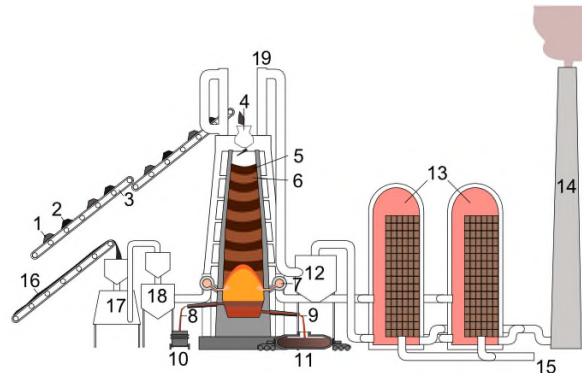


10 cm

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# Blast Furnace

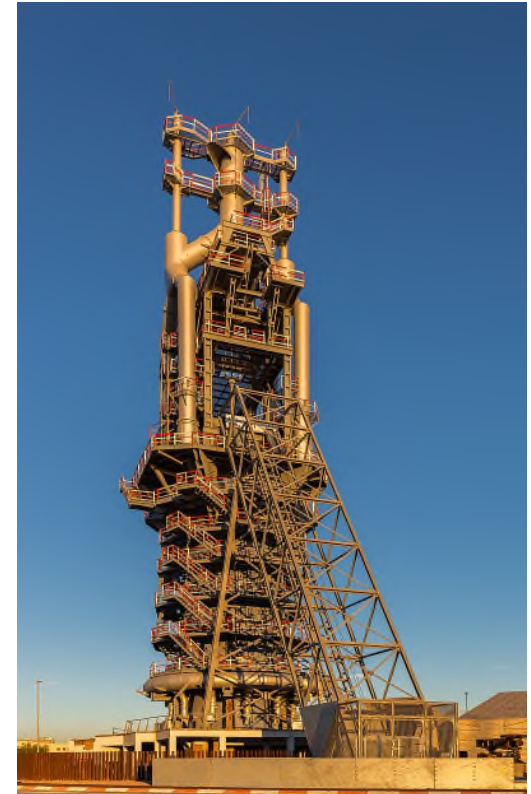
A blast furnace is a metallurgical furnace used for smelting iron ore to make pig iron. Iron ore, coke, and flux (limestone) are fed continuously into the furnace from the top, while pressurized hot air (or oxygen) is blown in from the bottom. The reaction that occurs results in molten pig iron and slag, both removed from the bottom of the furnace.



**Blast furnace placed in an installation**

1. Iron ore + limestone sinter
2. Coke
3. Elevator
4. Feedstock inlet
5. Layer of coke
6. Layer of sinter pellets of ore and limestone
7. Hot blast (around 1200 °C)
8. Removal of slag
9. Tapping of molten pig iron
10. Slag pot
11. Torpedo car for pig iron
12. Dust cyclone for separation of solid particles
13. Cowper stoves for hot blast
14. Smoke stack
15. Feed air for Cowper stoves (air pre-heaters)
16. Powdered coal
17. Coke oven
18. Coke
19. Blast furnace gas downcomer

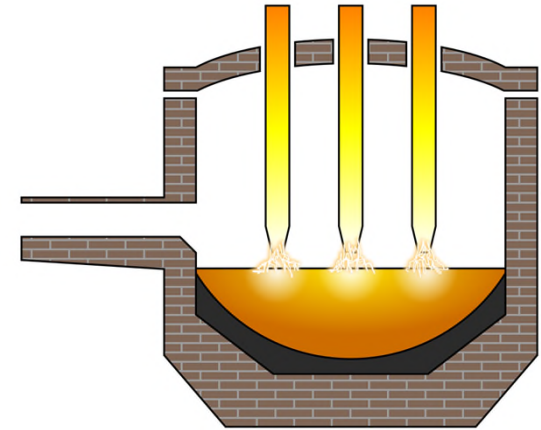
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## Electric Arc Furnace

An electric arc furnace uses electricity to heat the metal. They are used extensively in mini mills, where only scrap steel is used to make new steel (secondary production). The electrodes are made of high-purity graphite, and the current (arc) is in direct contact with the metal. The scrap is charged to the furnace, the roof is lowered, and the arc is struck. The use of electric arc furnaces allows 100% scrap steel to be used as feed, reducing the energy required to make new steel.



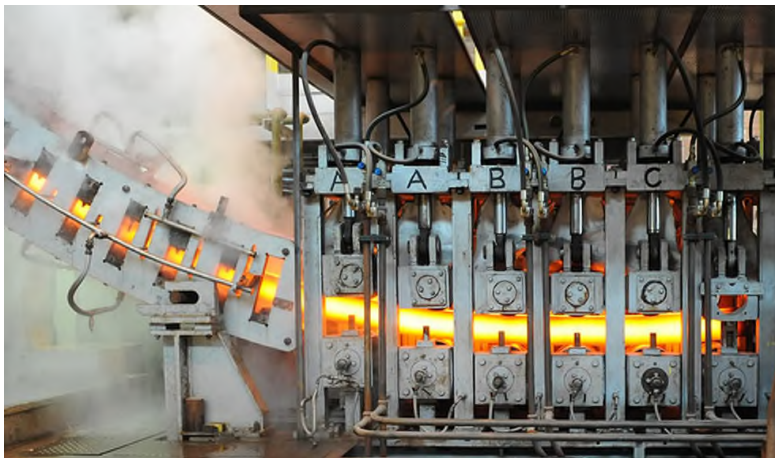
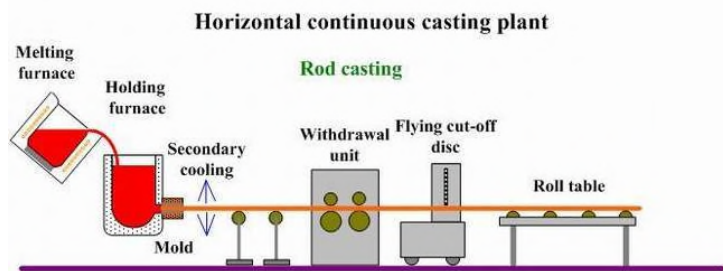
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# Continuous Casting

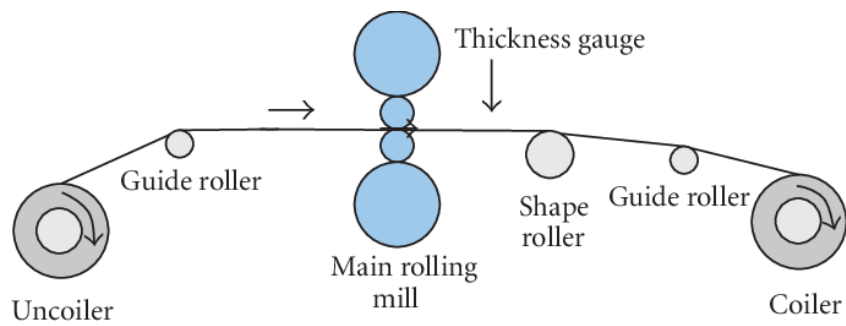


# Hot Rolling Mill





# Cold Rolling Mill

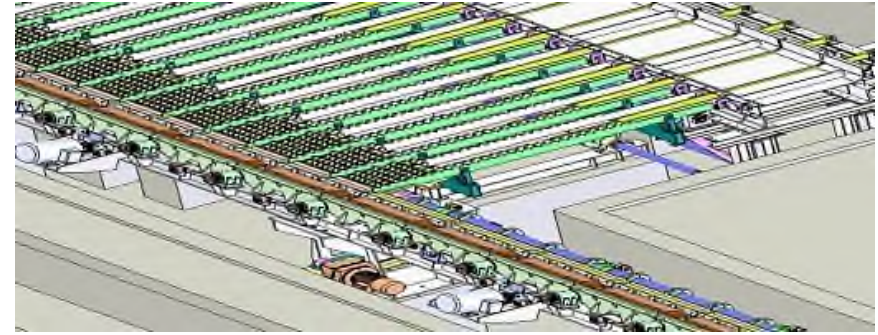


# Shear





## Cooling Bed





# **CITGO Lubricants for Steel Mill Applications**

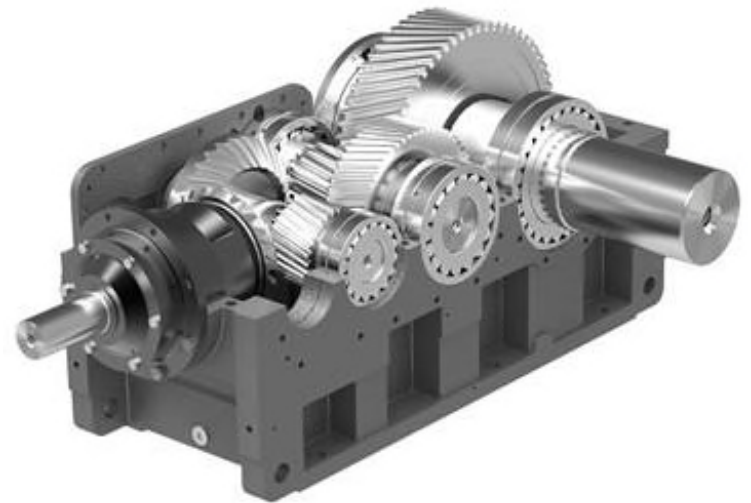
## EP Compounds

- Mineral oil based
- Extreme pressure products
- ISO 68 – 680 viscosity grades
- Oxidation and thermal resistance
- Excellent demulsibility and foam resistance
- Heavy duty steel-on-steel gears



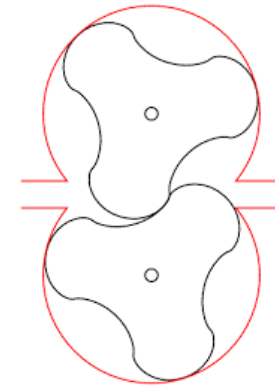
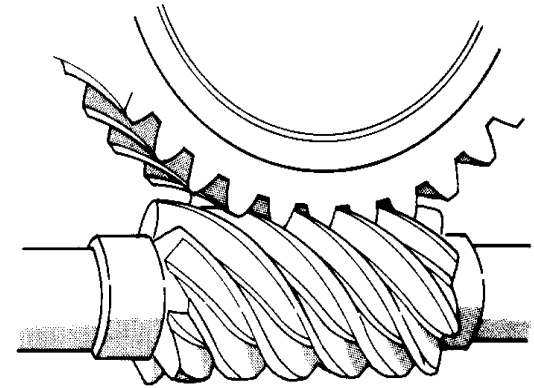
## CITGEAR Synthetic EP Gear Fluids

- Synthetic hydrocarbon based
- Polyalphaolefin (PAO)
- Extreme pressure products
- ISO 100 – 680 viscosity grades
- Excellent thermal and oxidation stability
- Longer life in extreme temperature applications



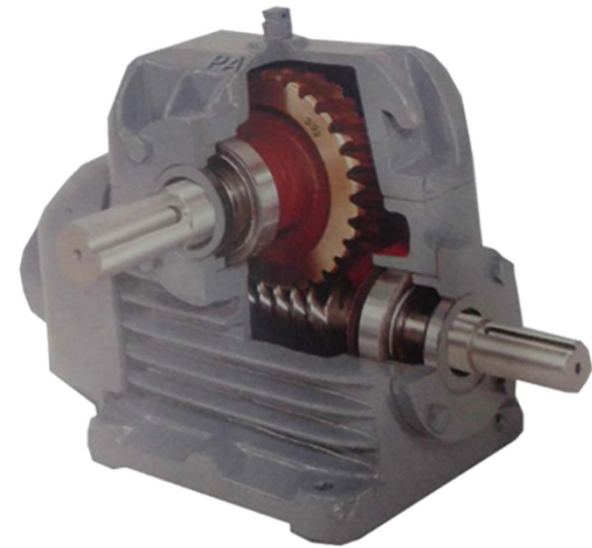
## CITGEAR Synthetic HT Fluids

- Synthetic hydrocarbon based
- Polyalphaolefin (PAO)
- Non-EP fluid
- ISO 68 – 1000 viscosity grades
- Excellent thermal and oxidation stability
- Extended life at extreme temperatures
- Used in worm gears and blowers



## CITGEAR Synthetic PAG Gear Fluids

- Polyalkylene glycol (PAG) based
- ISO 100 – 460 viscosity grades
- Excellent thermal and oxidation stability
- Resistant to sludge and deposit formation
- Low coefficient of friction – potential energy savings
- Steel-on-steel gears, rolling element bearings, worm gears





## CITGEAR XCO Oils

- Mineral oil based
  - ISO 100, 220, 320, 460
  - Excellent oil/water separation
  - High level of wear protection
  - Excellent oxidation stability and high thermal stability
  - Resistant to the formation of sludge and varnish
  - High speed rod mills – Danielli and Morgan (Siemens AG)
-






## Pacemaker SD Oils

- Mineral oil based
- ISO 220 – 680 viscosity grades
- Outstanding water removal properties
- Excellent corrosion protection and foam control
- Excellent filterability and deposit control
- Exceeds Siemens AG requirements for Morgoil® Advanced Bearing Lubricant “Super Demulsibility” specification



# CITGO FR WG-40XD

- Water-glycol fire-resistant hydraulic fluid
- 40 cSt @ 40°C
- Excellent fire resistance – no flash or fire point
- Enhanced lubricity, wear performance, foam inhibition, and corrosion protection
- Suitable for use at system pressure up to 3500 psi
- Excellent heat transfer properties
- Factory Mutual (FM) Approved
- Meets US Steel 171 and passes ASTM D2882 Vickers V104C pump test

 <b>FR WG-40XD HYDRAULIC OIL</b>		
<b>PRODUCT CODE</b> 648326001051	<small>FIRE RESISTANT GLYCOL WATER TYPE HYDRAULIC FLUID. FACTORY MUTUAL APPROVED. U.S. STEEL REQUIREMENT 171. PARKER DENSON HF-4. FOR INDUSTRIAL USE ONLY. * DO NOT USE WITH PETROLEUM OIL OR OTHER TYPE FLUID.</small>	
<b>NET WT./VOL.</b> 330 GAL 1249 L	<small>NJ N-1-K: WATER/GLYCOL</small>	
<b>TRACE CODE</b> Proof_2-13-2020	<b>Warning</b> <b>Hazard Statements:</b> Harmful if swallowed. Causes serious eye irritation. May cause damage to organs through prolonged or repeated exposure. (kidneys, liver) Injection of pressurized hydrocarbons can cause severe permanent tissue damage. Initial symptoms may be minor. <b>Prevention:</b> Wear eye or face protection. Do not breathe vapor. Do not eat, drink or smoke when using this product. Wash hands thoroughly after handling. <b>Response:</b> Get medical attention if you feel unwell. IF SWALLOWED: Call a POISON CENTER or physician if you feel unwell. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF eye irritation persists: Get medical attention. <b>Disposal:</b> Dispose of contents and container in accordance with all local, regional, national and international regulations.	
<b>FILL SEQ.</b>	<b>HWDG:</b> Injection of petroleum hydrocarbons requires immediate medical attention. <b>Supplemental GHS Or Other Regionally Regulatory Information:</b> RTK, N.A. The following components are listed: DIISOPROPYLETHANOLAMINE; ETHANOL, 2-(2-ISI-METHYLETHYL)AMINO; WTK, PA. The following components are listed: ETHANOL, 2'-OXYBIS-	
<b>SerialNo/V</b>		
<small>Don't Pollute... Conserve Resources: Return Used Oil to Collection Centers</small>		
		
		
<small>For transportation emergencies, call CHEMTREC (800) 424-9300 For health emergencies, call (821) 486-4700 Consult SDS for More Information</small>		<small>Rev. #: 01/2017/21 Rev. Date: 2/12/2020</small>
<small>Manufactured in the U.S.A. • CITGO Petroleum Corporation • 1283 Eldridge Parkway, Houston, TX 77077 • 832-486-4700 • www.citgolubes.com</small>		<small>719470</small>





## Lithoplex ST

- Mineral oil based – 440 cSt @ 40°C
  - Lithium complex thickener
  - NLGI 1 and 2 grades
  - Smooth and adhesive
  - Excellent extreme pressure (EP) and antiwear (AW) properties
  - Excellent water resistance
  - Excellent corrosion protection and oxidation stability
  - Excellent pumpability
  - Dyed green for easy identification
  - Rolling mills, work rolls, strip mills
-



## SynDurance ST Synthetic 220 and 460

- Synthetic base fluid – PAO fluids
  - 220 and 460 cSt @ 40°C
  - NLGI 1 and 2 grades for each viscosity grade
  - Smooth and adhesive
  - Outstanding low-temperature pumpability
  - Excellent oxidation stability for extended life
  - Excellent mechanical stability
  - Excellent EP and AW performance
  - Excellent water resistance and corrosion protection
  - Dyed purple for easy identification
-

# Process Machinery Applications

Machinery	Part	Lubricant	Advantage
<b>Overhead Cranes</b>	Bearings	SynDurance ST	Synthetic, extended operating temperature, wear protection, extended lubricant life
		Lithoplex ST	Good operating temperature range, wear protection, good lubricant life
	Hydraulics	CITGO FR WG-40XD	Factory Mutual approved fire resistant fluid
		CITGO Hydraulic AW 68	Good operating temperature range, wear protection, good lubricant life
<b>Continuous Casting</b>	Bearings	SynDurance ST	Synthetic, extended operating temperature, wear protection, extended lubricant life
	Hydraulics	CITGO FR WG-40XD	Factory Mutual approved fire resistant fluid
	Gear Drives	CITGO CITGEAR Synthetic EP	Synthetic, extended operating temperature, wear protection, extended lubricant life
<b>Continuous Cutting</b>	Bearings	SynDurance ST	Synthetic, extended operating temperature, wear protection, extended lubricant life
	Gear Drives	CITGO CITGEAR Synthetic EP	Synthetic, extended operating temperature, wear protection, extended lubricant life
<b>Cooling Area</b>	Bearings	SynDurance ST	Synthetic, extended operating temperature, wear protection, extended lubricant life
		Lithoplex ST	Good operating temperature range, wear protection, good lubricant life
<b>Reheat Furnace</b>	Bearings	SynDurance ST	Synthetic, extended operating temperature, wear protection, extended lubricant life
	Blowers	CITGO CITGEAR Synthetic HT	Synthetic, extended operating temperature, wear protection, extended lubricant life
	Gear Drives	CITGO CITGEAR Synthetic HT	Synthetic, extended operating temperature, wear protection, extended lubricant life
	Hydraulics	CITGO FR WG-40XD	Factory Mutual approved fire resistant fluid

# Process Machinery Applications

Machinery	Part	Lubricant	Advantage
<b>Hot Rolling Area</b>	Bearings	SynDurance ST	Synthetic, extended operating temperature, wear protection, extended lubricant life
		Lithoplex ST	Good operating temperature range, wear protection, good lubricant life
	Backup Roll Bearings	CITGO Pacemaker SD	Super demulsibility performance, wear and corrosion protection
	Gear Drives	CITGO CITGEAR Synthetic EP	Synthetic, extended operating temperature, wear protection, extended lubricant life
		CITGO EP Compound	Good operating temperature range, wear and corrosion protection
	Hydraulics	CITGO FR WG-40XD	Factory Mutual approved fire resistant fluid
<b>Rod Mill</b>	Bearings	CITGO CITGEAR XCO	No twist rod mill performance, wear and corrosion protection
	Gear Drives	CITGO CITGEAR Synthetic EP	Synthetic, extended operating temperature, wear protection, extended lubricant life
		CITGO EP Compound	Good operating temperature range, wear and corrosion protection
	Hydraulics	CITGO Hydraulic AW	Good operating temperature range, wear and corrosion protection
<b>Coiler</b>	Bearings	SynDurance ST	Synthetic, extended operating temperature, wear protection, extended lubricant life
		Mystik JT-6 Synthetic Hi-Temp	
		Lithoplex ST	Good operating temperature range, wear protection, good lubricant life
<b>Conveyors</b>	Bearings	SynDurance ST	Synthetic, extended operating temperature, wear protection, extended lubricant life
		Lithoplex ST	Good operating temperature range, wear protection, good lubricant life



## Questions

- Please post your questions using the Q&A function.
-



## How to Contact Us

- Lubes Answer Line

800-248-4684

8:00 AM - 12:00 PM, 1:00 PM – 5:00 PM CT  
Monday through Thursday

8:00 AM - 12:00 PM, 1:00 PM – 4:30 PM CT  
Friday

[lubeshelp@citgo.com](mailto:lubeshelp@citgo.com)

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## Future Webinars

July 23, 2021

Wear Modes and Failure Analysis

August 6, 2021

Contaminants in Lubricants

August 20, 2021

Lubricants Technology Services

September 3, 2021

LubeAlert Oil Condition Monitoring

September 17, 2021

Sales to Heavy Duty Fleet Prospects

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