Ingersoll Rand – Flowserve Decoker Winches

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Key Facts

COMPANY HISTORY
- Ingersoll-Rand is 145 years old. The company was founded when Simon Ingersoll patented the steam-powered rock drill in 1871.
- The Ingersoll-Rand Company was first incorporated on June 1, 1905.

COMPANY HEADQUARTERS
- Ingersoll Rand is incorporated in Swords, Ireland.
- Ingersoll Rand’s North American Headquarters and Corporate Center is located in Davidson, North Carolina.

NEW YORK STOCK EXCHANGE
- Ingersoll Rand (NYSE: IR) has been listed continuously on the New York Stock Exchange since October 11, 1906.
- Ingersoll Rand is the 18th oldest company and the 12th oldest continuously listed company on the NYSE.
- Ingersoll Rand’s stock ticker is IR
Ingersoll Rand

- Ingersoll Rand (NYSE: IR), a $15B diversified industrial company
- 58,000 Worldwide employees
- Worldwide facilities and logistic centers serve global customers
- Brands (13 SBU’s)
  - Trane®, ThermoKing®
  - Club Car®
  - Ingersoll Rand® Industrial Technologies
  - ARO®

Our Global Footprint

Manufacturing, Distribution & Office Locations

**LOCATIONS**

- **America**
  - 384 Climate
  - 75 Industrial
  - 24 Corporate

- **Europe, Middle East, India, and Africa**
  - 137 Climate
  - 31 Industrial
  - 21 Corporate

- **Asia Pacific**
  - 134 Climate
  - 59 Industrial
  - 2 Corporate

**World-Class Talent in Every Market**
More than 58,000 employees

**Global Footprint and Ingersoll Rand Locations**
We have a total of 867 facilities
Ingersoll Rand®

- **Industrial Technologies Brands (4 SBU’s)**
  - Air Compressor Technologies
  - Power Tools (Industrial Lifting Equipment-ILE)
  - ARO® Fluid Handling (pumps/oil)
  - Material Handling

Worldwide Footprints

- World-class manufacturing and assembly centers in key regions
- Leverages massive base of Ingersoll Rand resources, facilities, and personnel
Market Overview & Opportunity

Market - Oil & Gas (drilling and production)

- Offshore drilling: drill ships, semi-submersibles, jack-up rigs
- Onshore drilling: Land rigs
- Certifications, type approvals, witness tests (mainly offshore)
  - DNV
  - ABS
  - Lloyd’s register
  - NORSOK
  - CE
Material Handling – Key Markets

Oil & Gas
(Drilling & Production)

Refineries

Decoker Winches – Refineries
Ingersoll Rand sold Ingersoll-Dresser Pumps to Flowserve in 2000

Working with Flowserve ever since

Material Handling – WINCH BASICS
Winch vs. Hoist

Winch Nomenclature

Valve
Band Brake
Drum
Lifting Lug
Outboard End
Upright
Siderail
Disc Brake
Inboard End
Motor
**Winch Basics**

- **Top layer**
  - Maximum speed
  - Minimum line pull

- **Mid layer**
  - Medium speed
  - Medium line pull

- **First layer**
  - Minimum speed
  - Maximum line pull

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**Winch Orientation**

- Operator behind winch, but not in-line with wire rope.

- **Standard Overwound:**
  - Right hand on throttle handle.
  - Left hand on band brake (if equipped).
Winch Orientation Options

The Three Power Sources for winches/hoists

- **Pneumatic (Air)**
  - Generally at 90 psi, but can be as low as 60 psi and as high as 105 psi.
  - Segment also includes Compressed Natural Gas.
- **Electric (AC)**
  - Three phase (3Φ) 230-575V (50 & 60Hz)
- **Hydraulic (Oil)**
  - Generally between 1700-2500 psi, but not higher than 3000 psi.
### Air vs. Electric vs. Hydraulic

#### Advantages & Disadvantages

<table>
<thead>
<tr>
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<th>Air</th>
<th>Electric</th>
<th>Hydraulic</th>
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<tbody>
<tr>
<td><strong>Proportional Speed</strong>&lt;br&gt;(Load Spotting)</td>
<td>Excellent</td>
<td>Not without VFD</td>
<td>Very Good</td>
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<tr>
<td><strong>Use in Hazardous</strong>&lt;br&gt;Areas</td>
<td>Most Suitable</td>
<td>Very Expensive</td>
<td>Suitable</td>
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<tr>
<td><strong>Suitability for</strong>&lt;br&gt;Shock Loading</td>
<td>Excellent</td>
<td>Poor</td>
<td>Good</td>
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<tr>
<td><strong>Power Distribution Efficiency</strong></td>
<td>Poor</td>
<td>Excellent</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Suitability for Automation</strong></td>
<td>Not without Add-on’s</td>
<td>Excellent</td>
<td>Very Good</td>
</tr>
<tr>
<td><strong>Cleanliness</strong></td>
<td>Poor&lt;br&gt;Disadvantage:&lt;br&gt;Oil in the exhaust.</td>
<td>Extremely Clean</td>
<td>Good&lt;br&gt;Disadvantage:&lt;br&gt;Tend to have leaks.</td>
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<td><strong>Control Distance Limitations</strong></td>
<td>Full Flow: 20’&lt;br&gt;Pilot Air: 66’ (20m)&lt;br&gt;E/A: None&lt;br&gt;E/A = Electric-over-Air</td>
<td>None</td>
<td>Limited only by&lt;br&gt;Cold Ambient&lt;br&gt;Temperature</td>
</tr>
<tr>
<td><strong>Operating Medium Toxicty</strong></td>
<td>Low Toxicity&lt;br&gt;Disadvantage:&lt;br&gt;Lubrication in the air.</td>
<td>N/A</td>
<td>Toxic</td>
</tr>
<tr>
<td><strong>Required Setup Time</strong></td>
<td>Rapid</td>
<td>Time Consuming&lt;br&gt;Exception:&lt;br&gt;1Φ Portable Winches</td>
<td>Time Consuming</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td>No Auto Band&lt;br&gt;Brake Technology</td>
<td></td>
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*Continued...*
Radial Piston Motor Composition

- Radial Piston Air Motor
  - Best Proportional Control
  - Most Moving Parts
  - Low Speed (800rpm)

Decoking Winches/Hoists:

Force 5 (FA5/3119) vs.
FA5i/DCOKR Infinity Winch Series
FA5/3119
Air Powered Decoking Winch

- Work horse of industry for more than 20 years
- Rated Single Line Pull for hoisting - 5,000 lbs.
- Rated Single Line Speed - Variable up to 100 fpm

- Automatic Failsafe Brakes - One enclosed oil bath Disc and one Drum (band type) brake
- Drum Lock - Spring loaded pin type for use when winch is not in use
- Drum Guard - Zinc plated, expanded metal; fully adjustable for appropriate rope take-off
FA5/3119
AIR POWERED DECOKING WINCH

Options - Press roller, grooved drum, and other rope spooling devices are available to promote proper rope spooling and increase rope life.

Infinity™ Winch Series History

- Re-design of popular Force 5 Air Winch Series
  - Additional and improved features & options
  - Shorter manufacturing lead time
  - Fabricated steel frames
  - Customizable
- FA5i/DCOKR
  - Made exclusively for FLOWSERVE
  - Reduced gearing of load
  - Air, Hydraulic, Electric, E/A, E/H
Infinity Series – FA5i-DCOKR winch

Available Configurations:
- Pneumatic (FA5i-DCOKR)
- Hydraulic (FH5i-DCOKR)
- Electric (FE5i-DCOKR)
- E/A
- E/H
- Customer controls

Infinity Series – FA5i-DCOKR winch

Auto Disc and Auto Band Brakes (Dual Brakes)

Standard Automatic Band Brake  Standard Automatic Disc Brake
Full Flow Control Options (1 & 2XX)

- **Local Throttle**
- **Remote Throttle**

- Improved spotting control.
- Less complex than Pilot.
- 20’ rule-of-thumb max limitation on remote installations.

Remote Pilot Control Options (3XX & 4XX)

- **Pilot Control Valve**
  - Allows for distant control (66’ rule-of-thumb max).
  - Can integrate additional, complex controls.
- **Pilot Lever**
- **Pilot Pendant**
Electric-over-Air Control Option (5XXX)

- Allows for unlimited distance between winch/hoist and controls.
- Uses DC power signals to shuttle air valves at the winch to control motor and brake(s).
- NEMA 4 enclosures.

Comparison of Current and Previous Generation of Winches

### Force 5- FA5/3119
- Introduced in 1985 and stopped in 2005
- Reducer has been discontinued
- Lifting Lug Welded on Frame
- One Drum Guard Panel
- Cable Wire Rope Anchor
- K5B-REMOTE Control Valve discontinued

### FA5i- “Infinity”
- Introduced in 2005
- Certified / Rated Lifting Lugs
- Modular Guarding System
- Improved Drum Lock
- Wedge Style Anchor
- K5C2-X Control Valve – Better spotting capability
- Low Pressure Disc Brake
- Improved Frame Integrity
- No Welds in Frame Components

Some parts on the FA5/3119 are no longer able to be produced or sourced, making the work of overhauling unpredictable and very costly
What has not changed

- Same Full Drum Rating
- Same Performances (line pulls – line speeds)
- Same Wire Rope Capacities
- Same motors
- Same Foot Print Base – easy upgrade to current generation.

FA5i Lifting Lugs are Certified / Rated

Certified lifting lugs provide a safe and consistent lifting point
Modular Guarding System on the FA5i

FA5

FA5i

Stronger guard for improved safety, galvanized for better corrosion prevention, and modular for easier, less expensive replacement

Improved Drum Lock on FA5i

FA5

FA5i

More robust and durable design with more ergonomic handle for operator comfort
Wedge Style Cable Anchor on FA5i

Easier wire rope installation

No Welds in FA5i Frame Components

Single machined uprights improves durability and capability to withstand ambient temperature extremes
Better Spotting with the K5C2-X Control Valve

Increased control of load provides safer environment and reduces risk of damage from the moving load.

Low Pressure Disc Brake on FA5i

Automatic disc brake ensures load will be controlled in the case of a power loss.
Better Frame Integrity with (3) Dowel Pins on FA5i

Ensures durability and alignment of base winch frame and anchor points.

Force 5 Infinity Winch
WHAT TO DO WITH OBSOLETE WINCHES??????
Trade-In Program for old winches

• Ingersoll Rand discontinued all parts support for the old FA5-DCOKR and FA5/3119 winches at the end of 2017
  - Notification of this was sent to several times since 1/16/17
• There is a large fleet in the refinery marketplace
  - IR and Flowserve want to help the refineries who have these obsolete models to upgrade to current product
• After Dec 31, 2017 these models are not serviceable should they need maintenance
• OLD models that qualify for trade-in credit:
  - FA5-DCOKR
  - FA5/3119

Force 5 Infinity Winch
OVERVIEW of DECOKER WINCH CONTROLS
Decoking Control Console (DCC)

- Winch Controls
  - Throttle Valve
  - Brake Release Valve
Decoking Control Console (DCC)

- System Controls
  - Rotary Joint Control Valve
  - Drill Stem Latch Valve
  - Digital Indicators Showing Cutting Tool Position, Speed, and/or Wire Rope Tension

Decoking Control Console (DCC)

- System Controls Continued......
  - Drill Stem Limit Switch Solenoid Valve
Decoking Control Console (DCC)

Air Preparation Package
- Filter
- Lubricator
- Muffler

Electric over Air Controls (E/A)
- Unlimited distance between operator and winch
  - Safety
  - Space Limitations
- Integrate the winch and rotary joint motor w/ other system controls
- Maintain the same winch functionality as with air controls
System Options

• All controls can be electrically interlocked with other system elements
• All electric controls can be integrated into systems level control consoles
• All valves can be controlled via Intrinsically Safe Operators
• All valves can be controlled via PLC
• Air pendant operation for emergency backup

SUMMARY

The use of a remote controls make it easier to control the winches, rotary joints, and related equipment from one location.
Pneumatic Rotary Joint Motors

The 50259-4 is a flange mount radial piston air motor used on our popular FA2 air winch and Herculink air chain hoists. It has a female spline shaft end, and five bolt holes for direct mounting. The air motor has infinite variable speeds, develops maximum torque at low rpm and can be stalled-started-stopped and reversed without damage. It’s ideally suited for the petroleum, decoking, and material handling industries.

Features
- 9.4 hp at 1200 rpm and 50 ft lbs of torque.
- 76 ft-lb stall torque.
- Efficient five cylinder radial design.
- Sealed oil bath lubrication minimizes wear.
- Motor mounted throttles or remote mounted controls.
- Variable speed, with excellent low speed torque.
- Easy installation.

Accessories
- Muffler, (1-1/4 in) 52465
- Filter, (1-1/4 in) F42-04-000
- Lubricator, (1-1/4 in) L40-04-000
- Regulator, (1-1/4 in) R39-04-G00
How Ingersoll Rand is Different

3rd Party Agencies

- Customers worldwide rely on various, independent 3rd party certifying agencies to review and approve equipment to their own standards and others
- IR offers type approval, in-process manufacturing survey inspection, and witness testing by:
  - American Bureau of Shipping (ABS)
  - Det Norske Veritas (DNV)
- IR offers witness testing by:
  - ABS, DNV, Lloyds & Client
Cold Weather

• Standard low end design temperature for most products is 0°C (32°F).
• “Cold Weather” or “Charpy” configurations are available, with a design temperature of -20°C (-4°F)*
  - Depending on the mechanical stress on the part, the raw material may change to a more impact-resistant grade.
  - Additional heat treating (normalizing or annealing) is employed
  - Charpy “V-Notch” Impact Testing is conducted on coupons from raw material for all load bearing components

*Currently working on “COLDER WEATHER” configurations

Troubleshooting – Maintenance Discussions on Lessons Learned
Troubleshooting-Maintenance:

- Spooling issue because of the current drum design that can accommodate 3/4 or 5/8 inch wire rope. A drum flange spacer was designed so the spooling with 5/8 inch wire rope will be better.

As Received

Bent Inboard Upright
Elongated dowel pin and bolt holes

Bent Outboard Upright and Elongated Holes

Elongated dowel pin and bolt holes

Wire Rope Coming Out Through Outboard Upright
Drum Hub Bearing
Troubleshooting-Maintenance:

• Locking dog and it’s function as a parking brake only. Sheared locking dog as a result of when the locking dog is engaged while winch is still operating.

![Ergonomic Drum Locking Pin]

Ergonomic Drum Locking Pin is cam-operated and engages machined holes in drum flange to act as a parking brake to hold loads while winch is not in operation.

Troubleshooting-Maintenance:

• Damaged press rollers due to application.

![Press Roller]
Troubleshooting-Maintenance:

• Damaged press rollers due to application. A new design was done to solve the issue.

Troubleshooting-Maintenance:

• The importance of adjusting the brake band yearly as the lining wears down, annual load test using the drill stem, importance of oil changes, importance of daily operator inspections before start of shift, benefits of periodic inspections, and lastly good service record keeping.

• The benefits of every five years overhaul instead of waiting until winch is not operating. Yearly inspection, load testing, and brake testing. We can provide training for maintenance staff.

• Air to hydraulic or electric (E/A)- this is a bigger project that will need engineering design and may cost more than purchasing a new winch.

• Hydraulic winches- Refineries that have experienced winch damages because personnel have forgotten to open the case drain.
Close Case Drain

- With a closed manifold (case) drain, pressure builds up inside the motor which then results in a ruptured shaft seal.
- When seal is ruptured, hydraulic fluid flows along the drive shaft, through the disc brake and into the reducer housing.
- Reducer housing pressurizes and results in a blown end cover.
- When end cover is fractured, the sun gear disengages from the drive shaft and planetary assembly falls into the drum.
- The drill stem will drop but, depending on the height of the fall, if the control is immediately returned to neutral, the auto band brake will stop the winch drum rotation. Note that the disc brake will not stop the winch because the drive shaft is now disengaged.

Ruptured Motor Seal
Result – Damaged Reducer End Cover
Case Drain: Solution

• Keep case drain valve open at all times unless maintenance needs to be done.
• If case drain is to be closed, each shift operator to include checking the case drain valve as part of their daily inspection.
• Another solution is installation of a ruptured disc with a 30 psi rating.

Thank you

Ingersoll Rand – Flowserve
Working TOGETHER

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