



# Vulcan Tactile Systems

*Leading Edge Manipulator/Robotic  
Technology*



# What is It?

- *Telesmanipulator using an industrial robot*



# What's New?

- *The use of Tactile Force Feedback to allow manually control of Industrial Robots*
- *Provides three modes of operation*
  - *Manual*
  - *Semi-Automatic*
  - *Fully Automatic*



# How does this benefit the User?

- *The technology allows an operator to manually access and use the functionality of an Industrial Robot at Production speeds in real time*
  - Robots no longer require pre-programming to perform tasks
  - A library of motions, accessible by operator, make complex movements simple (Angular planes, radiuses, etc.)



# Features

Optional Automatic Tool Change

Optional Gantry Crane Mounting Structure

Onboard cameras provide operators a complete view of work area

Operator Cab

Spindle w/optional Tool Change

Standard Configured Industrial Robot

Impact Resistant Shield

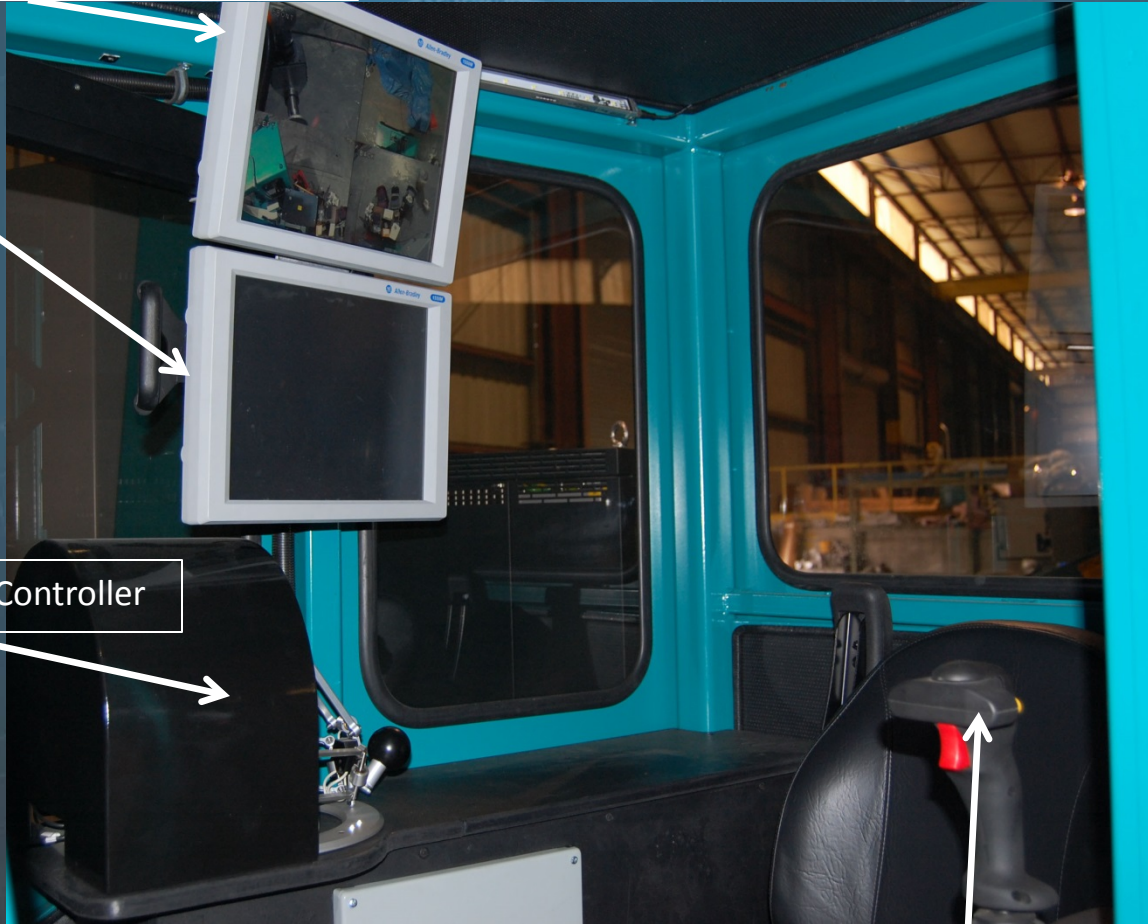
# Features - Operator Cab

Camera Screen to Monitor Work Area

HMI

Tactile Feedback Controller

Joy Stick to orient tool



# Features - HMI Main Screen

MAIN - /Gantry\_Grinder\_betaRev5// (Display)

**VTS**  
HANDS ON ROBOTICS

**MAIN**  
9:09:17 AM  
Friday, March 22, 2013

**VE VULCAN**  
ENGINEERING CO.

**SPINDLE**

0 RPM

SPINDLE START STOP

**LIGHTS**

CAB ON OFF

WORK ON OFF

**ROBOT**

FAULTS CLEAR

FEEDBACK ENABLED

MOTORS ON

ROBOT START STOP

**NAVIGATION BUTTONS**

MAIN TOOL CHANGE GRIND MODES STATUS RESET ALARM HISTORY

Spindle Control and Status

Work and Cab Light Controls

Menu for other functionality

Robot Control and Status

# Features - HMI Grind Modes

The screenshot displays the HMI interface for Grind Modes. At the top, it shows the VTS logo, the title 'GRIND MODES', the time '9:10:41 AM', the date 'Friday, March 22, 2013', and the VULCAN ENGINEERING CO. logo. The interface is divided into several sections: 'SPEED' with buttons for 0.5 X, 1 X, 2 X, 3 X, 4 X, and 8 X; 'MODES' with buttons for AUTO GRIND, PLANAR MOTION, and CUT; 'CUT' with START and STOP buttons; 'Z LOCK' with a 0 mm display and up/down arrows; and 'HAPTIC TUNING'. At the bottom, there are 'NAVIGATION BUTTONS' for MAIN, TOOL CHANGE, GRIND MODES, STATUS, RESET, and ALARM HISTORY. A box labeled 'Cut Mode' has an arrow pointing to the CUT button in the MODES section.

Speed and Scale selection

Allows large or precise movements of the Robot

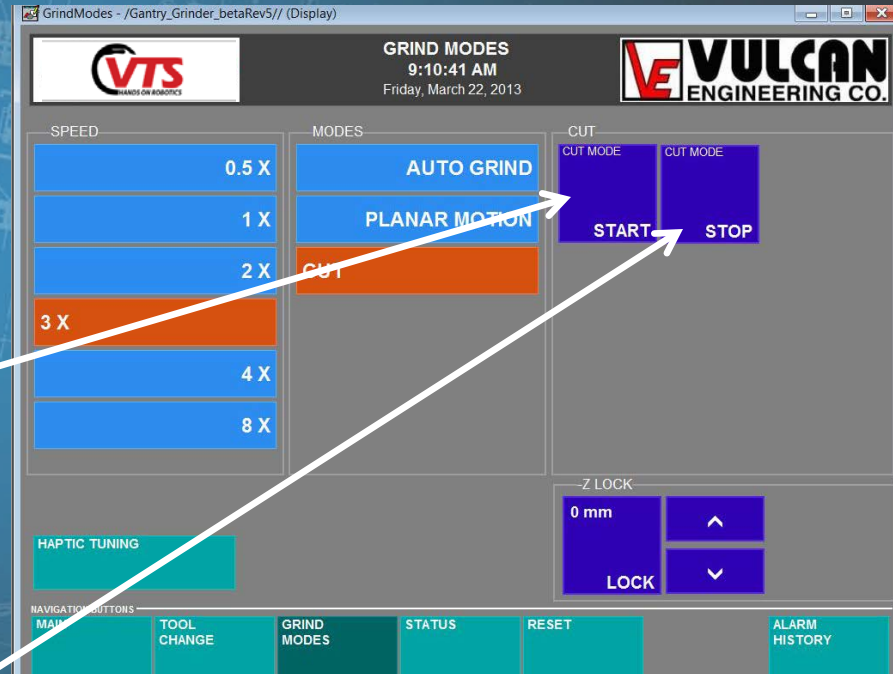
Motion Library allows for selection of Cut Mode, Planar Motion, Auto Grind or others

Cut Mode



# Cut Mode

- *Operator Positions Robot at desired angle*
- Presses Cut mode Start
- Using Tactile controller Operator cuts through  
When cut is completed, operator presses stop and repositions for the next cut

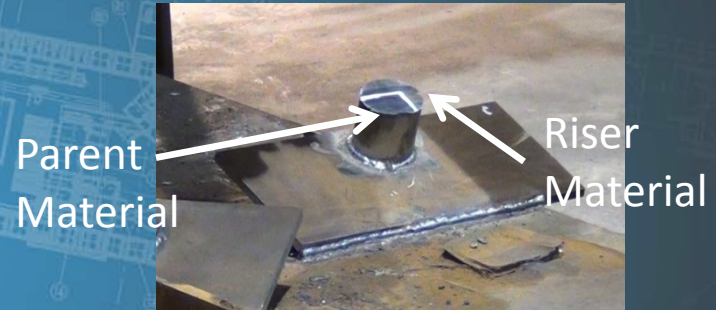


# Simulated Riser Cut Off on a complex angle



# Additional cutoff functionality

- Cutting of risers requiring multiple cuts from different directions.
- Cutting of riser that are wrapped around the casting



Simulated riser wrapped around the castings, note riser is also on a angle



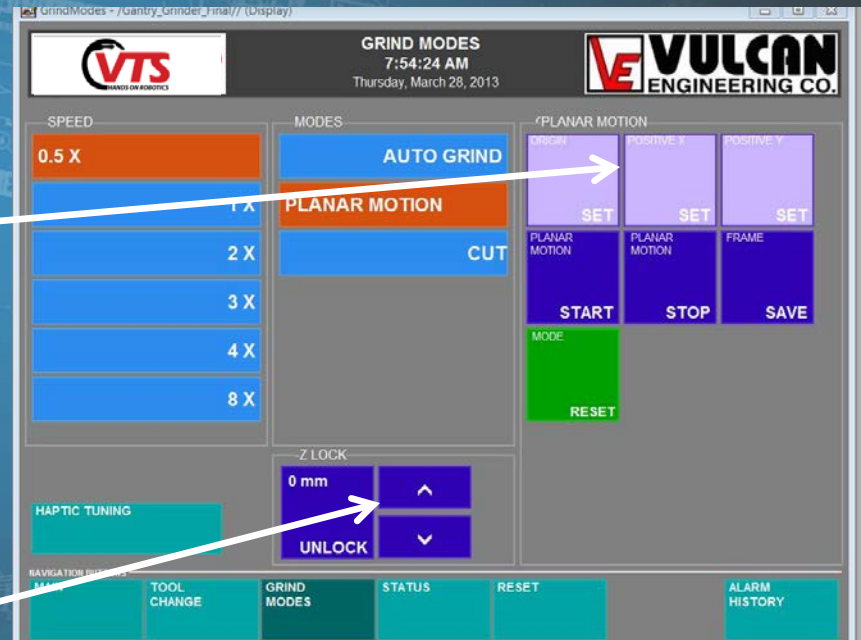
Step 1, make vertical cuts



Step 2, Make horizontal cuts

# Planar Mode

- *Operator Moves the robot and touches three places on the casting, to record a plane*
- The operator moves the grinding wheel around the casting removing flash or risers located on the recorded plane.
- If additional material removal is required, the plane height can be adjusted with the push of a button moving the plane in 1 mm increments

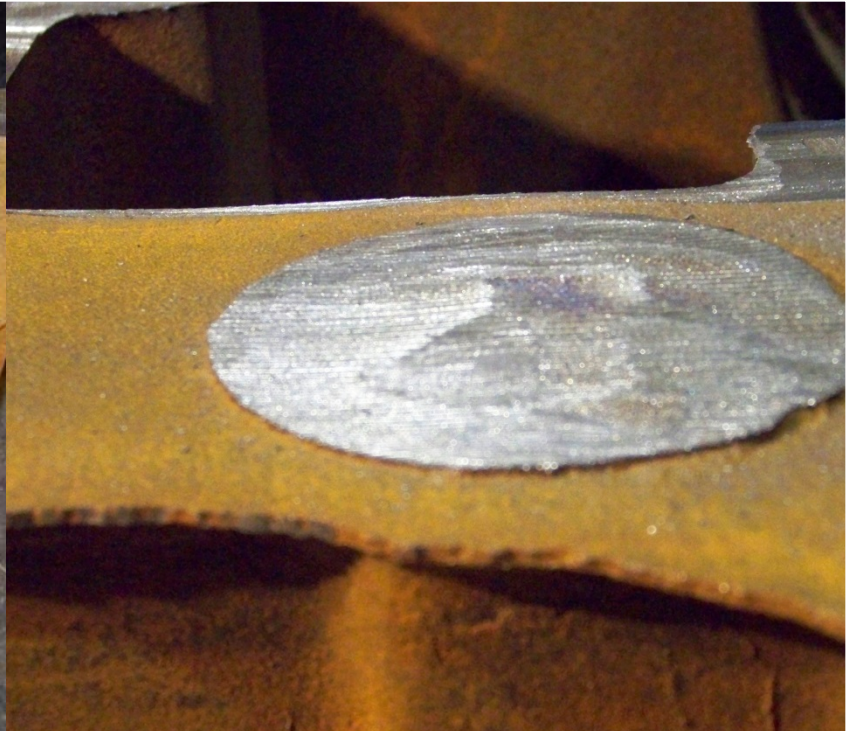


# Riser Grinding



Before  
↓

After  
↙ ↘



# Basic configurations

- Floor Mounted
- Gantry Mounted (shown)
  - Easy to move around casting or multiple bays
- Track mounted



# Options

- *Current options*
- Grinding / Cutting Spindles
  - Hydraulic, 75 HP
  - Electric with tool change, 40 HP
- Turntables for full automatic control
- Camera system for monitoring area around the machine
- Outfitted for attaching to gantry





# Summary of Features

- *General:*
  - Handling of large loads
  - Applying large forces
  - Robotic motions - planar, circular, complex (all computer calculated and guided)
  - Impact glass and environmentally controlled cab for operator protection
- *Manual Control Mode:*
  - Tactile feedback
  - Operator can choose computer guided motions such as planar motion in virtually any orientation of the tool (only limited by physical limits of robot workspace).
- *Semi-Automatic:*
  - Operator inputs basic points to orient robot and then selects desired automatic function such as gate grinding
- *Automatic:*
  - Machine is placed into a "cell" with locating pins and bushings to perform pre-programmed tasks, just as in any typical robot cell.



# Competitive Advantages

Description	Vulcan	Competition	Vulcan Advantage
Manipulator	Uses standard configured Industrial Robot	Custom designed and built machine	<ol style="list-style-type: none"><li>1. Vulcan solutions use the path following capabilities of the robot to easily, accurately and repeatedly move through complex motions</li><li>2. Parts and service for the robot available locally world wide</li></ol>
Force Feedback	Tactile feedback, electronic based on force sensor input	Custom designed, based on following error or hydraulic differential pressure	<ol style="list-style-type: none"><li>1. Tactile force feedback is the latest technology available. Very precise feel providing precise control over the task.</li><li>2. Competition does not use direct force measurement to provide force feedback. These type systems are mechanically isolated from the forces generated by the cutting /grinding operation. Since small movements required by cutting/grinding do not create large following error or pressure differentials actual operational forces are hard to detect</li></ol>

# Competitive Advantages

Description	Vulcan	Competition	Vulcan Advantage
Force sensing device	Mounted at the tool	None	1. Three degrees of freedom of force measurement at the tool for true measurement of force providing feedback and direction of the actual forces being generated giving the operator real time feedback and greater processing control at the tool face.
Modes of Operation	Manual, Semi-Automatic and fully automatic	Only manual	1. Three modes of operation provides the versatility to select the most productive method of operation for the task at hand.

# Competitive Advantages

Description	Vulcan	Competition	Vulcan Advantage
Controls	Latest PLC and industrial computer control plus HMI	Antiquated proprietary boards (non-PLC) and pushbuttons	<ol style="list-style-type: none"><li>1. Great flexibility and ease of use</li><li>2. Complete diagnostics and alarms on the screen</li><li>3. Scalable hand control enables the operator to move large distances or very small precise distances on demand</li><li>4. Operator selectable force feedback adjustments made easily from the HMI</li></ol>

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