TC-46/46M

High Performance Heavy Duty Lathe
With years of experience, combining advanced technology and facilities, YCM has successfully developed highly rigid CNC Turning Centers, TC-46/46M. TC-46/46M is specially designed for producing large workpieces with high accuracy, suitable for valve and hydraulic components, shipbuilding, automobiles, construction and energy industries. What’s more, TC-46M is equipped with C-axis and motorized turret that provides a wide range of complex milling functions.
Perfect Spindle Design

- Equipped with A2-11 spindle nose and 15" chuck. (18"/21"/24" chuck or customized fixture is optional.)
- The chuck is operated by pedal switch for more safety and user-friendly.
- The clamping pressure can be adjusted according to workpiece shape and material.
- Extra large bearing with excellent rigidity for heavy duty cutting capability.

The Extra Large Front Bearing

- The extra large front bearing internal diameter is ø180 mm 7.09" to ensure the heavy duty cutting capability.
- Max. hole through spindle diameter is ø130 mm 5.12".
- Max. hole through draw bar is ø117 mm 4.61".
- To ensure the precise assembly quality, the spindle bearing is adopted by quill design instead of direct assembly on head casting. All quills for spindle are all precisely ground and assembled at constant temperature control room, which present the spindle with best quality and longer life.

Big Bore Hole Through Design (opt.)

- A2-15 spindle of Big bore hole for flexible chuck 15"/18"/21"/24", hole through Spindle ø182 mm ø7.17".
- Suitable for the long workpiece (by boring and drilling), oil pipe (with optional dual chucks).

Max. Turning Length

<table>
<thead>
<tr>
<th>Turning Range</th>
<th>TC-46</th>
<th>TC-46M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>1650</td>
<td>2300</td>
</tr>
<tr>
<td>Max. Turning</td>
<td>ø750 mm</td>
<td>ø1650 mm</td>
</tr>
<tr>
<td>Diameter</td>
<td>ø29.5&quot;</td>
<td>ø65&quot;</td>
</tr>
<tr>
<td>Max. Turning</td>
<td>911 mm</td>
<td>1,561 mm</td>
</tr>
<tr>
<td>Length</td>
<td>35.9&quot;</td>
<td>61.46&quot;</td>
</tr>
</tbody>
</table>
Rigid Structure Design

- MEEHANITE® casting frame through FEM analysis for one piece torque tube and 45 degree slant bed ensures the best rigidity and eliminates casting distortion.
- Z-axis design with an extra wide distance of 620mm 24.41” between guideways offers the highest rigidity.
- The box way base of 950mm 37.4” is suitable for heavy duty machining and powerful chip removal.

Central Lubrication System

- The slide ways of X/Z-axis and ball screws are lubricated. Built-in alarm will be occurred when the lubrication oil is insufficient.

Automatic Tool Pre-setter Reduces Setup Time (Opt.)

- Optional automatic tool pre-setter reduces setup time.

The Smoothest X-axis Movement and Prevents Turret Drop

- The hydraulic balance cylinder on X-axis ensures the smoothest axial movement and brake system prevents the turret from dropping when the power is suddenly off.
- With the double nuts design, the ball screws on the X/Z-axis provide the highest rigidity.
- The optional safety clutch will disconnect the ball screw from motor to protect the ball screw during a crash.
User-Friendly Design

- Optional hydraulic (manual) steady rest for turning long workpieces.
- The movable controller panel provides users with the most user-friendly operating convenience.

Double-wide Safety Window

The operator can easily observe the machining area. The safety window possesses the characteristics of high grinding-resistance and anti-chemical which conforms to the CE's regulation EN12415-C3.

Bright Illumination

- Lighting is according with CE's regulation 500Lux.
- Save energy.
- Long lifetime.

Visual Management Design

The pressure gauge is installed on machine frontage, so that operators can always view hydraulic pressure. Also, there are multiple safety windows are set up for easy maintenance.

Equipped with Manual steady rest or hydraulic steady rest to support long workpiece.

- Manual steady rest (opt.)
  - ø40 mm~ø250 mm
  - ø1.57”~ø9.8”
  - ø250 mm~ø460 mm
  - ø9.8”~ø18.1”

- TC-46M /1000~3200
  - Hydraulic steady rest (opt.)
- TC-46M /3200
  - Two hydraulic steady rests (opt.)
Efficient Chip Disposal System

- With slanted design and superb chip removal space under the spindle, it is more easier to clean chips.
- High pressure coolant is supplied for optimal chip removal.
- Shower coolant from the roof help removing chips which accumulated on chuck and telescopic guideway cover. (opt.)

Rotary Controller Panel

90° rotary availability.

Coolant Capacity

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC-46/1000</td>
<td>465L</td>
</tr>
<tr>
<td>TC-46M/1000</td>
<td>465L</td>
</tr>
<tr>
<td>TC-46/1650</td>
<td>540L</td>
</tr>
<tr>
<td>TC-46M/1650</td>
<td>540L</td>
</tr>
<tr>
<td>TC-46/2300</td>
<td>700L</td>
</tr>
<tr>
<td>TC-46M/2300</td>
<td>700L</td>
</tr>
<tr>
<td>TC-46/3200</td>
<td>1,060L</td>
</tr>
<tr>
<td>TC-46M/3200</td>
<td>1,060L</td>
</tr>
</tbody>
</table>

Programmable tail stock

- MT-5 fixed quill with live center is standard, high rigidity rotary quill with dead center is optional.
- Tail stock using dual cylinder to clamp the guideways for prevent tail stock skid during machining. Using hydraulic connect bar to link the tail stock and carriage for tail stock positioning to save time.
TC-46

SPECIAL TURRET DESIGN

Equipped with Large Servo Turret
Equipped with large 10T (12T, opt.) servo driven turret that features fast turret indexing (0.9 sec.) and machining versatility.

Extended Tooling Cavity
Extended tooling cavity design allows extra space for tooling maneuverability.

Large Diameter of Curvic Coupling
The large diameter of 3-piece curvic coupling design offer super rigid clamping force to ensure heavy cutting and long-term accuracy.

TC-46M

Fast & Reliable Motorized Turret
- 12 tools capacity with BMT 85 tooling system.
- Max. live tool power 15/18.5/22 kW 20/25/30 HP with Max. speed 3,000 rpm.
- Servo drive turret for high speed index.
- Hydraulic clamping turret by 3-piece large clutch for heavy duty cutting.
**Perfect Spindle Design**

**Powerful 4 Speed Gear-head Spindle**

- Suitable for heavy duty machining requirements.

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**Excellent Thermal Stability**

- The spindle is built-in with high torque and 4 speed gear box design.
- With oil-cooling system of oil circulating for spindle bearings and gears, greatly cooling down the raising temperature.

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**Powerful 2 speed Gear-head Spindle and Head cooling**

- Spindle quill /Gearbox with oil-cooling system for excellent thermal stability.
- Spindle motor power 30/37 kW 40/50 HP with 2 speed gear box.
- Max. torque 380 kgf-m 2748.59 lbf-t
- C-axis with rotary encoder for 0.001 degree positioning to provide excellent machining accuracy.
POWER CHART

TC-46

TC-46M

TC-46/46M Big Bore

Shift 4  2,000 rpm

Shift 3  1,062 rpm

Shift 2  456 rpm

Shift 1  240 rpm

Low Speed 500 rpm

High Speed 2,000 rpm

Low Speed 1,200 rpm

High Speed 1,200 rpm

kW  HP

kgf-m  lb-ft

Shift 4  2,000 rpm

Shift 3  1,062 rpm

Shift 2  456 rpm

Shift 1  240 rpm

Low Speed 500 rpm

High Speed 2,000 rpm

Low Speed 1,200 rpm

High Speed 1,200 rpm

kgf-m  lb-ft

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Low Speed 500 rpm

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kgf-m  lb-ft

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kgf-m  lb-ft

Shift 4  2,000 rpm

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Shift 1  240 rpm

Low Speed 500 rpm

High Speed 2,000 rpm

Low Speed 1,200 rpm

High Speed 1,200 rpm

kgf-m  lb-ft
CUTTING CAPACITY
TC-46M / 3200

**OD-TURNING S45C Steel**
- Metal Removal Rate: 988 cc/min.
- Workpiece Diameter: 200 mm
- Spindle Speed: 255 rpm
- Feedrate: 166 mm/min.
- Cutting Speed: 160 m/min.
- Depth of Cut: 10 mm

**U-DRILL S45C Steel**
- Cutter Diameter: ø80 mm
- Tool: ø80 mm
- Spindle Speed: 500 rpm
- Feedrate: 60 mm/min.
- Cutting Speed: 126 m/min.

**END MILL S45C Steel**
- Depth of Cut: 7 mm
- Tool: ø32 mm x 4T
- Spindle Speed: 1,500 rpm
- Feedrate: 900 mm/min.
- Cutting Speed: 151 m/min.

**FACE MILL S45C Steel**
- Depth of Cut: 5 mm
- Tool: ø80 mm x 6T
- Spindle Speed: 1,200 rpm
- Feedrate: 576 mm/min.
- Cutting Speed: 301 m/min.

**U-DRILL S45C Steel**
- Cutter Diameter: ø34 mm
- Spindle Speed: 1,500 rpm
- Feedrate: 150 mm/min.
- Cutting Speed: 160 m/min.
- Depth of Cut: 20 mm

**TAP S45C Steel**
- Tapping: M24 mm
- Tool: M24 x 3P
- Spindle Speed: 60 rpm
- Feedrate: 180 mm/min.
- Cutting Speed: 5 m/min.
TC-46M

12T

Unit: mm inch
### Machine Dimensions

#### TC-46 /1000 /1650 /2300
TC-46M /1000 /1650 /2300

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC-46 /1000</td>
<td>380</td>
<td>14.06&quot;</td>
<td>5,763</td>
<td>226.89&quot;</td>
<td>3.335</td>
<td>131.3&quot;</td>
<td>1,670</td>
<td>65.75&quot;</td>
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<tr>
<td>TC-46M /1000</td>
<td>380</td>
<td>14.06&quot;</td>
<td>6,413</td>
<td>252.48&quot;</td>
<td>3.985</td>
<td>156.89&quot;</td>
<td>1,560</td>
<td>61.42&quot;</td>
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<tr>
<td>TC-46 /1650</td>
<td>380</td>
<td>14.06&quot;</td>
<td>7,328</td>
<td>288.5&quot;</td>
<td>4.900</td>
<td>192.91&quot;</td>
<td>1,560</td>
<td>61.42&quot;</td>
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<tr>
<td>TC-46M /1650</td>
<td>380</td>
<td>14.06&quot;</td>
<td>8,265</td>
<td>325.39&quot;</td>
<td>5.830</td>
<td>229.53&quot;</td>
<td>1,620</td>
<td>63.78&quot;</td>
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<tr>
<td>TC-46 /2300</td>
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<td>7.990</td>
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<tr>
<td>TC-46M /2300</td>
<td>380</td>
<td>14.06&quot;</td>
<td>11,063</td>
<td>443.16&quot;</td>
<td>9.990</td>
<td>393.31&quot;</td>
<td>3,750</td>
<td>147.64&quot;</td>
</tr>
</tbody>
</table>

*Machine dimensions of TC-46/46M. Big Bore are identical with TC-46M of above list.*

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#### TC-46 /3200
TC-46M /3200

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<thead>
<tr>
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<tbody>
<tr>
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<td>10,863</td>
<td>443.16&quot;</td>
<td>9.990</td>
<td>393.31&quot;</td>
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<td>147.64&quot;</td>
</tr>
</tbody>
</table>

*Machine dimensions of TC-46/46M. Big Bore are identical with TC-46M of above list.*
<table>
<thead>
<tr>
<th>MACHINING CAPACITY</th>
<th>TC-46</th>
<th>TC-46M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swing Over Bed</td>
<td>ø850 mm ø33.5&quot;</td>
<td></td>
</tr>
<tr>
<td>Swing Over Carriage</td>
<td>ø720 mm ø28.4&quot;</td>
<td></td>
</tr>
<tr>
<td>Max. Turning Diameter</td>
<td>ø750 mm ø29.5&quot;</td>
<td>ø730 mm ø28.7&quot;</td>
</tr>
<tr>
<td>Max. Turning Diameter</td>
<td>1,000 mm 39.4&quot;</td>
<td>1,000 mm 126&quot;</td>
</tr>
<tr>
<td>Max. Turning Length*3</td>
<td>1,650 mm 65&quot;</td>
<td>1,561 mm 61.4&quot;</td>
</tr>
<tr>
<td>Max. Turning Length*3</td>
<td>2,300 mm 90.6&quot;</td>
<td>2,211 mm 87&quot;</td>
</tr>
<tr>
<td>Max. Turning Length*3</td>
<td>3,200 mm 1000</td>
<td>3,111 mm 122.5&quot;</td>
</tr>
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</tr>
</tbody>
</table>

**SPINDLE**

<table>
<thead>
<tr>
<th>Distance Between Center</th>
<th>Standard</th>
<th>1,199 mm 47.8&quot;</th>
<th>1,849 mm 73.4&quot;</th>
<th>2,498 mm 99&quot;</th>
<th>3,399 mm 134.5&quot;</th>
<th>1,206 mm 47.5&quot;</th>
<th>1,856 mm 73.1&quot;</th>
<th>2,506 mm 98.7&quot;</th>
<th>3,406 mm 134.1&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Bore (opt.)*1</td>
<td></td>
<td>1,206 mm 47.5&quot;</td>
<td>1,856 mm 73.1&quot;</td>
<td>2,506 mm 98.7&quot;</td>
<td>3,406 mm 134.1&quot;</td>
<td>1,206 mm 47.5&quot;</td>
<td>1,856 mm 73.1&quot;</td>
<td>2,506 mm 98.7&quot;</td>
<td>3,406 mm 134.1&quot;</td>
</tr>
</tbody>
</table>

**SPINDLE SPEED**

<table>
<thead>
<tr>
<th>Spindle Speed</th>
<th>Standard</th>
<th>2,000 rpm (15&quot; / 18&quot;)</th>
<th>1,700 rpm (21&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Bore (opt.)*1</td>
<td>1,200 rpm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Max. Spindle Torque | 510 (380*1) kgf-m 3,688.9 (2,748.6*1) lb-ft | 380 kgf-m 2,749 lb-ft |

| C1-axis Index Accuracy | 0.001 |

**GUIDEWAY**

<table>
<thead>
<tr>
<th>X-axis Guideway Width</th>
<th>370 mm 14.57&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-axis Guideway Width</td>
<td>620 mm 24.41&quot;</td>
</tr>
</tbody>
</table>

**BASE/SADDLE TILT ANGLE**

| Base/Saddle Tilt Angle | 45° |

**MAIN TRAVEL**

<table>
<thead>
<tr>
<th>X-axis Travel</th>
<th>405 (375+30) mm 15.94&quot;(14.76&quot;+1.18&quot;)</th>
<th>415 (365+50) mm 16.34&quot;(14.37&quot;+1.97&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-axis Travel</td>
<td>1,000 mm 39.4&quot;</td>
<td>1,650 mm 65&quot;</td>
</tr>
</tbody>
</table>

**FEED**

<table>
<thead>
<tr>
<th>X-axis Rapid Feedrate</th>
<th>16 m/min. 629.9 ipm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-axis Rapid Feedrate</td>
<td>18 m/min. 708.7 ipm</td>
</tr>
</tbody>
</table>

| Cutting Feedrate (X/Z) | 1~10,000 mm/min. 0.04~393.7 ipm |

**MOTOR**

<table>
<thead>
<tr>
<th>Spindle Motor</th>
<th>30 / 37 kW 40.2 / 49.6 HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial Motor (X/Z)</td>
<td>4 kW / 7 kW 5.4 / 9.4 HP</td>
</tr>
<tr>
<td>Turret Motor</td>
<td>1.8 kW 2.4 HP</td>
</tr>
<tr>
<td>Live Tool Motor</td>
<td>- 15 / 18.5 / 22 kW 20 / 25 / 30 HP</td>
</tr>
</tbody>
</table>

*1 TC-46 Big bore series: Head drive structure is identical with TC-46M, plugged with 2 speed gear box.
*2 Wide selection of manual steady rest available: ø40~250 and ø250~460 mm.
*3 Max. Chuck size is up to 24": standard size: 15", big bore: 18". Please refer to the travel diagram.
Note: The manufacturer reserves the right to modify the design, specifications, mechanisms, etc. to improve the performance of the machine without notice. All the specifications shown above are just for reference.
### TURNING RANGE

<table>
<thead>
<tr>
<th>TC-46</th>
<th>TC-46M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>1650</td>
</tr>
</tbody>
</table>

#### TURRET
- **Tool Type**
  - Servo Motor Drive (Hydraulic Clamp)
- **Tool No.**
  - TC-46: 10T (12T)
  - TC-46M: 12T
- **Standard Tool**
  - Shank Height for Square Tool: 32 mm
  - Shank Dia. for Boring Bar: ø60 mm ø2&1/2”
- **Max. Diameter When Turret Rotation**
  - ø982 mm ø38.7”
  - ø1,465 mm ø57.7”
- **Live Tool Speed**
  - 3,000 rpm
- **Torque of Milling Tool Motor**
  - 13 kgf-m 94 lb-ft

#### TAIL STOCK
- **Tail Stock Quill Diameter**
  - ø150 mm ø5.9”
- **Tail Stock Quill Taper**
  - MT No.5
- **Tail Stock Stroke**
  - ø982 mm ø38.7”
  - ø1,465 mm ø57.7”

#### LUBRICATION
- **Lubrication Pump**
  - 150 W (YMGP-302FW-T6)
- **Lubrication Tank Capacity**
  - 6 L

#### HYDRAULIC SYSTEM
- **Volume**
  - 60 L
- **Pressure**
  - 50 kgf/cm²
- **Flow Rate**
  - 38.5 L/min. (60 Hz)
- **Motor**
  - 3.75 kW 5.03*

#### OIL COOLER
- **Oil Cooler Unit**
  - HBO-750P2TSSB2
- **Capacity**
  - 2,600 / 3,000 kcal/h (50 / 60 Hz)
- **Motor**
  - 0.75 / 0.75 / 1.18 kW (Inlet/Outlet/Compressor)
- **Flow Rate**
  - 25 / 30 L/min. (50 / 60 Hz)
- **Volume**
  - 22 L
- **Coolant**
  - 465 L 540 L 700 L 1060 L 465 L 540 L 700 L 1060 L
- **Pump**
  - 1.51 kW 2.02*(MTH4-40/4)

#### GENERAL
- **Power Consumption (Transformer)**
  - 71.56 kVA (80 kVA)
  - 76.38 kVA (100 kVA)
- **Machine Weight**
  - Standard: 12,500 kg 27,558 lb
  - Big Bore: 15,100 kg 33,289 lb
- **Floor Space (Length x Width x Height)**
  - Standard:
    - 5,070 x 2,745 x 2,570 mm
    - 5,720 x 2,745 x 2,570 mm
    - 6,635 x 2,745 x 2,570 mm
    - 7,560 x 2,745 x 2,570 mm
    - 5,450 x 2,745 x 2,570 mm
  - Big Bore (opt.)*1
    - 5,450 x 2,745 x 2,570 mm
    - 6,100 x 2,745 x 2,570 mm
    - 7,015 x 2,745 x 2,570 mm
    - 7,940 x 2,745 x 2,570 mm

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*1 TC-46 Big bore series: Head drive structure is identical with TC-46M, plugged with 2 speed gear box.
*2 Wide selection of manual steady rest available: ø40~250 and ø250~460 mm.
*3 Max. chuck size is up to 24”: standard size: 15”; big bore: 18”. Please refer to the travel diagram.

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## ACCESSORIES

| Tool Kit | Work Lamp | Pilot Lamp | Automatic Door | Safety Door | Hydraulic System | Tool No. | Tool holders | Spindle Cooling System | Hydraulic Hollow Chuck | Chuck & Hard Jaws and Soft Jaws 1 Set | Soft Jaws, Hard Jaws (Option accessories) | Soft Jaw Former 15" | Chuck Switch Pedal | Tail Stock Switch Pedal | Programmable Tail Stock | Tail Stock Quill Taper-Dead Center (w/ Live Center) | Tail Stock Quill Taper-Live Center (w/ MT5 Dead Center) | Complete Chip Enclosure | Leveling Blocks and Bolts | Foundation Screw Bolt | Air Gun | Cutting Air Blast | Coolant Equipment System | Coolant Gun | Oil Skimmer | Oil Mist Suction | Central Lubrication System | Chip Conveyor (Right Side) | Electrical Cabinet | Auto Tool Length Measurement System (RENISHAW HPMA) | Steady Rest | FANUC CNC Controller | Mechanical, Electrical, Operating Manuals |
|----------|-----------|------------|----------------|-------------|-------------------|----------|-------------|------------------------|------------------------|-------------------------------|-------------------------------------------|---------------------|---------------------|---------------------|------------------------|-----------------------------|--------------------------|-----------------------------|------------------|------------------|---------------------|
|          |           |            |                |             |                   |          | Normal Tool holders (Non-powered Turret) |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          | Live Turret BMT 85 12T |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          | Normal Turret 12T |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          | Normal Turret 10T |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |
|          |           |            |                |             |                   |          |                        |                        |                        |                               |                                |                   |                     |                     |                        |                             |                          |                             |                   |                        |                     |

### Notes:

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