Teaching an Old Dog New Tricks...Muscling Up the 2004R

Over the last few years there’s been a tremendous amount of interest in the GM 2004R transmission for high performance street vehicles. The performance gains from the lower first gear and overdrive are making it a great replacement for the 2-speed Powerglide and 3-speed TH350 and TH400.

The original internal component design and hydraulic calibration of the GM 2004R transmission limit its reliable power-handling capability to about 350 lbs-ft of torque. We’re all aware of the importance of a hardened sun shell and stator tube, but there are many other areas we can improve for optimum power handling.

Research and development and CNC machining have resulted in the introduction of aluminum and steel billet internal components that have pushed the limit beyond 700 lb-ft of torque.

Above this power level or for use with a transbrake, the overdrive section — input shaft, overdrive carrier, and overdrive ring gear — gets into trouble. These items are known to snap without warning, leaving you with a transmission that won’t move.

Always check the internal splines of the carrier and ring gear for twisting or fracturing. Most of them are cracked; if you reuse a cracked assembly, they’ll usually fail a short time later.

Once you’ve addressed the hard parts failures, there’s one more area to strengthen for high power handling: the direct clutch. Initial signs of trouble usually show up as a flare during the 2-3 upshift under heavy acceleration, and it doesn’t take long before that’s followed by direct clutch failure.

The Reason?

What are the real causes for the flare and premature direct clutch failure?

<table>
<thead>
<tr>
<th>ILL. NO.</th>
<th>DESCRIPTION</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>ORI MTV</td>
</tr>
<tr>
<td>2</td>
<td>REVERSE</td>
</tr>
<tr>
<td>3</td>
<td>MTV</td>
</tr>
<tr>
<td>4</td>
<td>DRIVE 2</td>
</tr>
<tr>
<td>5</td>
<td>3RD ACC.</td>
</tr>
<tr>
<td>6</td>
<td>LINE</td>
</tr>
<tr>
<td>7</td>
<td>EXHAUST</td>
</tr>
<tr>
<td>8</td>
<td>RND4D3</td>
</tr>
<tr>
<td>9</td>
<td>RND4</td>
</tr>
<tr>
<td>10</td>
<td>DETENT</td>
</tr>
<tr>
<td>11</td>
<td>DRIVE 4</td>
</tr>
<tr>
<td>12</td>
<td>DRIVE 3</td>
</tr>
<tr>
<td>13</td>
<td>LO/DETENT</td>
</tr>
<tr>
<td>14</td>
<td>3RD CLUTCH</td>
</tr>
<tr>
<td>15</td>
<td>MTV UP</td>
</tr>
<tr>
<td>16</td>
<td>MTV DOWN</td>
</tr>
<tr>
<td>17</td>
<td>ORI MTV DOWN</td>
</tr>
<tr>
<td>18</td>
<td>ORIFICE</td>
</tr>
<tr>
<td>19</td>
<td>GOVERNOR</td>
</tr>
<tr>
<td>20</td>
<td>2ND CLUTCH</td>
</tr>
<tr>
<td>21</td>
<td>4TH CLUTCH</td>
</tr>
<tr>
<td>22</td>
<td>LO</td>
</tr>
<tr>
<td>23</td>
<td>LO-1ST</td>
</tr>
<tr>
<td>24</td>
<td>COV. ORIFICE</td>
</tr>
<tr>
<td>25</td>
<td>LO OV</td>
</tr>
<tr>
<td>26</td>
<td>REV/OV</td>
</tr>
<tr>
<td>27</td>
<td>CONV. CL. SIGNAL</td>
</tr>
<tr>
<td>28</td>
<td>RND4 ORI</td>
</tr>
<tr>
<td>29</td>
<td>TV FEED</td>
</tr>
<tr>
<td>30</td>
<td>PART THROTTLE</td>
</tr>
<tr>
<td>31</td>
<td>PTDIS</td>
</tr>
<tr>
<td>32</td>
<td>ACCUMULATOR</td>
</tr>
<tr>
<td>33</td>
<td>TV</td>
</tr>
</tbody>
</table>

Figure 1

RND4D3 oil from the manual valve flows through separator plate hole #8
failure? In simple terms, the flow of oil to the direct clutch drum and the release side of the servo assembly is either too high or too low at different points in the fluid path.

**Examining the Circuit**

To recognize the complexity of the circuit and the purpose of the corrections, you’ll need to understand how the system works. The best way to do this is to use the hydraulic schematic and trace each step in the fluid path. Clear off your workbench and grab a case, valve body, and separator plate.

RND4D3 oil from the manual valve flows through separator plate hole #8 and into valve body passage #6 (figure 2). It stops here, waiting for the governor to stroke the 2-3 shift valve.

From here the oil must fill multiple passages and cavities before the unit completes the 2-3 shift. Combine this with the friction the oil encounters and the air that fills the voids when the circuits aren’t in use, and it’s easy to see why the unit requires a greater volume and oil pressure. So our first modification will be to increase the volume...
and pressure by enlarging separator plate orificed hole 8 to between 0.115" – 0.120" (figure 3).

The 2-3 upshift begins when the 2-3 shift valve opens. RND4D3 oil then passes through the open 2-3 shift valve and into the adjoining valve body passage 8, where it becomes direct clutch oil.

Direct clutch oil flows through separator plate holes 14 (the small and large round holes, figure 4) and into transmission case passage 5 (figure 5). This is where you'll find checkball 4.

During 3-2 downshifts or kickdowns, when direct clutch oil is exhausting through the direct clutch circuit, checkball 4 seats against the large round separator plate hole 14. This forces the exhausting direct clutch oil through the small round separator plate hole 14.

There's plenty of orificed direct clutch exhaust under the 2-3 shift valve and elsewhere without sealing the large round separator plate hole 14 with...
Direct clutch oil flows through separator plate holes 14 (the small and large round holes, figure 4)

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Checkball 4 (figure 6). Checkball 4 doesn’t do anything in high performance applications other than restrict direct clutch oil passing through the large square separator plate hole 14 and into valve body passage 8. So remove checkball 4 and seal the large round separator plate hole 14 (figure 7). Now drill out the small round separator plate hole 14 to 0.125".
Direct clutch oil, now in valve body passage 8 (figure 8), flows through the next large round separator plate hole #14

Remove checkball 4 and seal the large round separator plate hole #14
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(figure 9), into transmission case passage 6 (figure 10), and into the center support and direct clutch drum.

Direct clutch oil, now in valve body passage #8, flows through the next large round separator plate hole #14.
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At the same time, direct clutch oil flows to the release side of the servo assembly. This is to release the 2nd gear band at the same time it applies the direct clutch. This band release and clutch apply must be synchronized properly to eliminate bind-up and flare during the 2-3 upshift.

From valve body passage 8, direct clutch oil must flow into valve body passage #12 or the 3rd accumulator, where it can make its way to the servo.

Direct clutch oil is sent to the 3-2 control valve and separator plate orifices at the same time through separator plate #5.
clutch oil must flow into valve body passage 12 (figure 11) or the direct accumulator, where it can make its way to the servo.

This is the critical point for orificing direct clutch oil to the direct accumulator circuit. In stock form there are 2 possible routes the direct clutch oil can take from valve body passage 8 to valve body passage 12 during a 2-3 upshift, depending on the position of the 3-2 control valve.

Before continuing, let’s look at the function of the 3-2 control valve. The 3-2 control valve is located in valve body passage 8 and connects with valve body passage 12. The 3-2 control valve is held open by a spring; it’s gradually closed completely by governor oil acting on its large land as output shaft speed increases.

When the 3-2 control valve is open or partially open, it allows direct clutch oil to pass through a huge orifice into valve body passage 12. When the valve is closed, it forces direct clutch oil to flow through two separator plate orifices into valve body passage 12. In essence it provides variable orificing of direct clutch oil into the direct accumulator circuit, based on output shaft RPM.

According to GM technical manuals, this wasn’t its intended purpose. Its purpose was similar to checkball 4. And we’re left with two possible conditions:

Possibility 1 — The direct clutch oil flowing in valve body passage 8 will pass through an open or partially-open 3-2 control valve into valve body passage 12, while flowing through two separator plate orifices, past a checkball, and through another separator plate orifice into valve body passage 12.

Possibility 2 — Direct clutch oil flow will stop at a closed 3-2 control valve, while flowing through two...
Teaching an Old Dog New Tricks…Muscling Up the 2004R

separator plate orifices, past a checkball, and through another separator plate orifice into valve body passage 12.

NOTE: If the separator plate is OEM Monte Carlo SS HO, it will only use the large round separator plate hole 5.

Direct clutch oil flowing in valve body passage 8 is sent to the 3-2 control valve and separator plate orifices at the same time. After the oil passes through separator plate holes 5 (the small and large round holes, figure 12) it must flow past checkball 2 (figure 13) and out through separator plate hole 5 (the square hole, figure 14) into valve body passage 12.

Here's the key to the circuit: The optimum size orifice between the third clutch oil and third clutch accumulator oil circuits is 0.120” to 0.125”. Any possible 3-2 control valve position between fully open and fully closed, combined with the diameters of the small and large round holes, is much larger than the optimum orifice size of 0.120” to 0.125”.

How do we arrive at this orifice size? First we discard the factory 3-2 control valve spring and install a pump slide pivot pin spring to block the valve closed. This forces all of the direct accumulator oil through the separator plate orifice (figure 15).

Next we remove checkball 2 and seal off the large round separator plate hole 5. Enlarge the smaller round separator plate hole 5 to 0.120” – 0.125” to balance direct accumulator oil flow rates in proportion to direct clutch apply.

If you're using a billet shaft forward drum, you can also dual feed the direct clutch by leaving the center seal out of the direct drum, and plugging the hole in the 10mm center support retaining bolt that feeds the reverse side of the direct drum.

If you don’t want to fuss with plugging the holes in the plate, we’ve developed a low-cost replacement plate with the work already done. The redesigned separator plate alone pays big dividends in performance. With these modifications you can greatly extend the power-handling capabilities of the GM2004R transmission in any muscle car.

Christoforos Kokkonis is the owner and operator of CK Performance Products Inc. They specialize in design and manufacture of extreme duty transmission and internal components, and have a complete research and development and CNC shop. Visit them online at www.ckperformance.com.

Figure 16

This forces all of the direct accumulator oil through the separator plate orifice

Figure 15

Figure 16
AW55-50SN Shift Kit

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